HYDROGEOLOGIC EVALUATION OF THE DUREZ PLANT SITE

NORTH TONAWANDA N.Y.

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Ministry of the Environment
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OF THE

DUREZ PLANT SITE

REPORT TO
NIAGARA RIVER STEERING COMMITTEE
ONTARIO MINISTRY OF THE ENVIRONMENT

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FOREWORD

This report has been prepared for the Niagara River Steering Committee of the Ontario Ministry of Environment. The purpose of this report is to provide the ministry with an independent technical review and interpretation, from a hydrogeological standpoint, of the potential impact to the Niagara River from waste disposal operations at the Occidental Chemical Corporation, Durez Division plant. It is hoped that this report can be used to assist in the understanding of past and present hydrogeologic conditions and the development of satisfactory remedial measures.

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DATA SOURCES AND DATA INTERPRETATION

Much of the information presented in this report is based upon data acquired from two previous reports prepared for Hooker, Durez Division. The first report, dated 12 November 1980, is titled "Hydrogeologic Investigation for the Durez Site." The report was prepared by Recra Research Incorporated and Wehran Engineering P.C.. The report is referenced herein as Hooker (1980). The second report, dated November 1982, is titled "Report of Continuing Field Investigations Summer 1982." The report was prepared by the Durez Division of Occidental Chemical Corporation (which is the new name of Hooker Chemical Corporation). Dunn Geoscience Corporation assisted in the hydrogeologic interpretation and in piezometer installation. The report is referenced herein as Occidental (1982).

In many cases, it was necessary to compare elevation data extracted from the two reports. However, the data could not be compared without some manipulation. This was due to discrepancies in fixed elevations reported in Hooker (1980) and Occidental (1982). A fundamental source of the discrepancies is the different elevations ascribed to Durez Benchmark #2, the reference point upon which all elevations are based. Occidental (1982) reports an elevation of 101.08 feet (relative to Hooker datum) for Benchmark #2. Hooker (1980) reports Benchmark #2 as being at 100.08 feet. A third source of data, consisting of updated and corrected water table elevations submitted by Dunn Geoscience to the New York State Department of Environmental Conservation (NYSDEC) in January 1983 (Dunn Geoscience, 1983), reports Benchmark #2 as 101.08 feet. As the most recent data agree, 101.08 feet is assumed to be the correct elevation for Benchmark #2.

Dunn Geoscience (1983) contains ground elevations at piezometer locations, and elevations of the reference point of each piezometer. The reference point is used in determining water

level elevations and is the elevation of the top of the casing of each piezometer. Appendix F in Hooker (1980) also contains reference point and ground elevations for piezometers and wells. These elevations are with respect to the (assumed) incorrect benchmark elevations. An attempt was made to compensate for the benchmark discrepancy by adding one foot to elevations reported in Hooker (1980). A number of considerable differences still existed after compensation. Tables 1 and 2 show the differences in ground elevation and reference point elevation respectively. In order to effectively compare elevation data extracted from the three sources, it was necessary to select one set of elevations as being correct. Dunn Geoscience (1983) data were selected on the basis that they are the most complete, and also the most recent.

Many figures in this report are shown with data superimposed upon a schematic map of the Durez Plant area. The schematic map was scaled from a plant site map (Plate 4.1) from Occidental (1982). Piezometer locations and the route of two on-plant sewers were similarly scaled from Plate 4.1. The location of schematic map features (roads, railways, etc.) was checked by referring to a second map source of data, a city sewer map provided by the City Engineering Department of the City of North Tonawanda (City of N. Tonawanda, 1974b).

This report makes some use of contour diagrams. In all cases, contours were prepared using computer assisted linear interpolation techniques. Linear interpolation was used in order to reduce subjective interpretation of the data. It is recognized that, in some instances, the limited number of data points available for use in preparing a specific contour may render the accuracy of the contours open to question. Contours have not been extrapolated into regions where a paucity or total lack of data points make such extrapolation unreasonable.

In some instances, point averages of contaminant concentrations were determined from several analytical results. In these cases, sample analyses that resulted in the substance not being detected at or above a certain concentration were included in the average calculations as zero values. It is recognized that this methodology is conservative and may lead to understatement of contaminant concentrations.

1.0 BACKGROUND INFORMATION

The Durez Division of Occidental Chemical Corporation (formerly Hooker Chemical Corporation) is located in the City of North Tonawanda. The plant site covers an area of approximately 45 acres (Hooker, 1980) in the northeast part of the city, about 1.5 miles east of the Tonawanda Channel of the Niagara River. Figures 1, 2 and 3 show the plant location with respect to the Niagara Region, the City of North Tonawanda, and the immediate vicinity, respectively.

The plant is situated in a mixed residential/industrial area. Residential properties border the plant on Walck Road, Nash Road, Wilson Avenue, Harding Avenue and Farnsworth Avenue.

The plant has been in operation since 1926, producing chemicals for use by the plastics industry. A partial inventory of chemicals produced either presently or in the past includes: "phenolic resin, phenolic molding compound, hexamethylenetetramine, paratertiary-octyl phenol, zinc and calcium stearates, alkyd and diallyl phthalate molding compounds" (USEPA, 1982).

In 1976, the New York State Department of Environmental Conservation (NYSDEC) initiated a state wide Industrial Chemical Survey (ICS) program to identify industries which used, produced, stored or otherwise handled selected chemicals of concern. Chemicals of concern include most priority pollutants and hazardous substances as defined by applicable EPA regulations. The Durez ICS response indicated that the facility used over 50 million pounds per year of chemicals of concern with plant storage facilities exceeding 5 million pounds. Phenol use alone exceeded 30 million pounds (USEPA, 1982).

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Hooker Durez submitted a Resource Conservation and Recovery Act (RCRA) application to handle hazardous wastes. On site hazardous waste management facilities include "50,000 gallons of container storage, 540,000 gallons of truck storage, a 720 gallon per day solvent recovery unit, and a 720 gallon per hour incinerator." (USEPA, 1982).

Prior to 1977, an estimated 28,500 tons of waste materials (ITF, 1979) were landfilled at various locations on the plant property (Hooker, 1978). The wastes disposed of on-site include liquid phenol tar (containing chlorinated benzenes) and solid phenol bearing materials.

2.0 MONITORING FACILITIES

Since the local hydrogeology and contaminant migration are evaluated on the basis of the available data, the integrity and appropriateness of the monitoring facilities that provide these data are of some concern. Geologic information obtained during the installation of the monitoring facilities is useful in formulating a conceptualization of the local geology. For these reasons, the monitoring facilities at the Durez site will be described in some depth. Facilities can be conveniently subdivided into two groups: shallow piezometers for monitoring the water table zone (overburden), and deep wells for monitoring the bedrock aquifer.

2.1 Shallow Piezometers

Documentation is available on 49 piezometers that had been installed in the water table aquifer prior to August 1982. In addition to the aforementioned piezometers, Occidental (1982) notes that in early 1979, "16 wells were installed on the periphery of the Durez property". Occidental (1982) and Hooker (1980) usage of the term "wells" generally refers to shallow monitoring piezometers. There are no data available concerning these piezometers. As discussed in the next paragraph, it appears that most of these piezometers were replaced or abandoned. Documented piezometers are denoted P-1 through P-36, NP-1 through NP-11, and SWP-7, SWP-8 and SWP-9. Although the lettering indicates a total of 50 piezometers, NP-11 was installed as a replacement for P-28 which was abandoned some time between 18 June 1980 and 6 March 1982. Piezometer locations are shown in Figure 4.

Piezometers P-1 through P-30 were installed as a portion of the field work described in Hooker (1980). Piezometers P-24 through P-30 are replacements for "Old well points WP-1, WP-2, WP-3,

WP-6, WP-7, WP-13 and WP-16" (Hooker, 1980). Given their location at the site periphery (note that NP-11 is at the location of P-28) the old piezometers (well points) would appear to be those referred to in Occidental (1982) as being installed in 1979. Hooker (1980) also notes that "six existing well points, WP-8, WP-9, WP-10, WP-11, WP-14 and WP-15, were abandoned by pulling the PVC casing and sealing with a bentonite grout to the surface." If the assumption that WP-1 through WP-16 are the sixteen well points installed in 1979 is correct, then the location and disposition of WP-4, WP-5, and WP-12 remain unknown. Well logs in Appendix B of Hooker (1980) for P-24 through P-30 contain no geologic information. Piezometer installation only is documented. However, geologic information for P-26 and P-29 is reported in Occidental (1982) for soil borings immediately adjacent to these piezometer sites.

Piezometers P-31 through P-36 and SW-7, SW-8 and SW-9 were installed in November 1979 (Occidental, 1982). No data are available as to installation procedures. Soil borings reported in Occidental (1982) for locations adjacent to P-33, P-34, and P-36 provide geologic information for these piezometers.

Piezometers NP-1 through NP-11 were installed by Dunn Geoscience as part of the work described in Occidental (1982). Full well logs are available for NP-1 through NP-11.

Table 3 contains a summary of data regarding the shallow piezometers. Data sources and significance of data are as follows:

- ground elevations are extracted from Dunn Geoscience (1983). Elevations are with respect to Hooker Benchmark #2 at 101.08 feet;

- pH data is given for wells which show at least one pH measurement above 8. High pH values frequently

indicate cement contamination resulting from improper well installation. pH data for wells P-1 through P-30 were obtained from Hooker (1980). For these wells pH were measured in the field at the time of sample acquisition and/or subsequently at the analytical laboratory of Recra Research. pH data shown in Table 3 for well P-1 through P-30 are laboratory measurements unless noted otherwise. pH data for the remaining wells (P-31 through P-36, NP-1 through NP-11) are taken from Occidental (1982). Where no data is available the fact is noted.

- No comments for a piezometer indicate that all data for the piezometer can be considered "normal".

Some general notes should be made with regard to piezometer installation and construction:

- Piezometers were constructed with 1.25 inch steel well screens on 1.25 inch steel casing.

- According to Hooker (1980) piezometers P-1 through P-30 were installed with a two foot screened interval, the bottoms of which are at the surface of the glaciolacustrine clay. Occidental (1982) notes similar procedures for piezometers NP-1 through NP-11 with the exception of NP-3. NP-3 was installed with the total screened length below the surface of the glaciolacustrine clay. No data are available with regards to screen position for piezometers P-31 through P-36. It is assumed that a similar installation procedure to those described above was used. Although it is probably an error in log preparation, the well log for P-1 (Hooker, 1980) indicates that the bottom of the well screen is located 0.5 feet above the clay surface.

- Occidental (1982) states that "Upon installation, each piezometer was developed by pumping to remove residual material in an effort to produce turbid-free water." No mention is made of the success of the development procedures (i.e. whether in fact turbid-free water was produced).

- Subsequent to August 1982, a number of piezometers have been installed by both Occidental and NYSDEC. Occidental (1982) presents plans for a further thirty piezometers on the plant property. Several sewer bedding piezometers have been installed in the storm sewer bedding along Walck Road (Dick Hoffman, NYSDEC personal communication, 1983). No data has been released regarding the aforementioned piezometers.

2.2 Deep Wells

Four deep wells are available for monitoring the bedrock aquifer. Well locations are shown on Figure 5. Wells W-7, W-12 and W-16 are reconstructed industrial water supply wells formerly used by Durez. The rationale for well reconstruction was; "to assure the integrity of the sample obtained from the bedrock aquifer" (Hooker, 1980). W-17 is a newly drilled well. The drilling of W-17 and the reconstruction of W-7, W-12 and W-16 are described in Hooker (1980).

Briefly, reconstruction procedures used were as follows:

- caliper logs were taken to determine well condition;

- a four-inch steel casing was telescoped within the existing casing to a depth determined as appropriate

from the caliper logs. The bottom of the four-inch casing was previously fitted with an expandable packer;

- the annulus of the well above the packer was grouted with neat cement and sand.

The basis for selecting the depth of packer placement is stated in Hooker (1980) as:

> "In all cases, the location selected for packer was in a zone of unfractured, competent bedrock at least five feet below the base of the original casing. Any fractured bedrock zone immediately below the old casing was, therefore, isolated."

The drilling procedures for W-17 are too detailed for inclusion in this report. Table 4 shows pertinent information regarding the depths and elevations of the sampling intervals for wells W-7, W-12, W-16 and W-17. Ground surface elevations in Table 4 are from Dunn Geoscience (1983). Elevations of sampling intervals are calculated by subtracting depths reported in well logs (Hooker, 1980) from ground elevations.

It is of some importance, with regard to assessing chemical analysis results from the deep wells, to determine the depth below the top of the bedrock unit at which the sample interval is located. With the exception of W-17, there are no data in the deep well logs describing the geologic situation at the well locations. An approximate elevation of the bedrock surface can be determined by averaging the bedrock elevations obtained from those borings which were bored to that depth. Table 5 presents

the elevations of the bedrock surface. Elevations are calculated as described above for sample intervals. The depth to bedrock for borings P-1, P-10 and P-17 is not labelled explicitly on the logs. However, Hooker (1980) states:

> "During the drilling of piezometer P-1 P-10 and P-17, the soils were sampled continuously, using a standard two-inch split spoon sampler driven at two-foot intervals to bedrock."

It can be assumed, therefore, that the "End of Boring" depth in the logs for P-1, P-10 and P-17 is in fact the depth of the bedrock surface. The borings for P-1, P-10, and P-17 were subsequently backfilled to surface with cement grout and a piezometer installed in a shallow boring adjacent to the exploratory boring.

Table 6 shows the depth below bedrock surface of the top of the sampling interval in wells W-7, W-12, W-16 and W-17. Values for W-7 and W-12 and W-16 were calculated using the average bedrock surface elevation calculated in Table 5 and the top of sample interval elevation from Table 4. The value for W-17 is taken directly from the well log.

Taking account of the uncertainty associated with using an average value for bedrock surface elevation, it is nonetheless apparent that, in all cases, an interval of at least 20 feet exists between the top of the bedrock surface and the top of the sampling interval for the four deep wells.

Hooker (1980) also makes reference to additional former industrial water supply wells. Although these additional wells are not used as monitoring facilities, their existence and

disposition may be relevant to assessing potential for contamination of the bedrock aquifer. Hooker (1980) states that the wells "were identified and efforts were made to evaluate their condition and, if appropriate, properly grout seal them to prevent short circuiting between shallow and deep ground water systems." A further five deep wells were located. The wells are denoted W-2, W-4, W-9, W-11 and W-13.

Wells W-2 and W-13 were caliper logged, found to be in good condition, and as Hooker (1980) makes no mention to the contrary, are assumed to have been left open.

Well W-4, which was found to be obstructed by a detached pump column at a depth of approximately 50 feet, was grouted.

Well W-9 was clogged with debris to a depth of approximately 25 feet. The debris, consisting of "predominantly timber and brick with occasional trash" (Hooker, 1980), was blown out of the hole with air. Hooker (1980) notes the depth of W-9 as being "somewhat over 100 feet." After the debris had been cleared, the well was left open. No mention is made as to whether W-9 was caliper logged. The well bore diameter is noted as being 12 inches.

Well W-11 had a 8 inch casing plugged with concrete to a depth of six inches below ground surface. Below the concrete, the casing was plugged with paper, cloth, brick and wood (Hooker, 1980). This debris was cleared to a depth of 35 feet. The casing was blocked below 35 feet. W-11 was then grouted. Hooker (1980) notes; "While drilling, little water was produced but when the casing was left open overnight before grouting, the water had risen to approximately 14 feet below ground surface".

As a point of interest, it is worthwhile noting that the possibility exists of a number of deep wells that have not been located. Assuming a consistent well numbering system (i.e. W-1

through W-17), wells numbered 1, 3, 5, 6, 8, 10, 14 and 15 have not been accounted for. If they do in fact exist, their location and condition represents an unknown variable with respect to assessing contamination potential of the bedrock aquifer.

Table 7 summarizes the status of the deep wells.

La Sala (1968) references three wells owned by Durez Division, Hooker Chemical Corporation. Relevant details are presented in Table 8. It is not apparent whether the three wells referenced by La Sala (1968) are among those discussed in Hooker (1980).

3.0 GEOLOGY

3.1 Regional Geology

3.1.1 Overburden

The overburden materials are mostly unconsolidated glacial deposits formed during the Pleistocene era. The deposits consist of glacial till, glaciolacustrine clays, silts and sands, and glaciofluvial sands and gravels (La Sala, 1968).

The till consists of assorted clay, silt, sand, and stones, deposited directly upon the bedrock by glacial advance. The glaciolacustrine materials settled out from glacial lakes. The glaciofluvial sands and gravels were deposited from glacial streams.

Glacial deposits are generally less than 50 feet thick in the North Tonawanda area (La Sala, 1968).

3.1.2 Bedrock

Bedrock stratigraphy in the region consists of dolomite, shale, limestone and sandstone beds dipping gently to the south. The various groups are discussed from youngest to oldest below:

Salina Group

The Salina group was formed approximately 420 million years ago during the Upper Silurian Period. On a large scale regional basis, the group consists of Camillus shale overlain by Bertie Limestone, and has a thickness of approximately 400 feet.

The North Tonawanda region is a subcrop area of the Camillus shale. Consequently there is no Bertie Limestone present in the region. The thickness of the shale is less in the subcrop

area than that reported for the Salina group as a whole. La Sala (1968) describes the Camillus shale as: "Grey, red and green-blue bedded shale and massive mudstone. Gypsum occurs in beds and lenses as much as 5 feet thick. Subsurface information indicates dolomite (or perhaps more correctly, magnesium-lime mudrock) is interbedded with the shale". La Sala (1968) also notes: "The gypsum occurs principally in lenticular beds. The thicker beds may be 3 or 4 miles in lateral extent. The thinner beds can be expected to be much smaller in extent."

Lockport Group

The Lockport group is composed of five members forming an average thickness of 150 feet. Johnston (1964) identified five distinct zones within the Lockport. From uppermost to lowermost these zones are:

a) brownish-grey, coarse-to medium-grained dolomite, locally saccharoidal (finely textured) with thin intervals of curved bedding (algal structures)
b) grey to dark grey, fine-grained dolomite, containing abundant carbonaceous partings
c) tannish-grey, fine-grained dolomite
d) light grey, coarse-grained limestone containing abundant crinoid fragments (Gasport Limestone Member)
e) light grey, shaly dolomite, laminated in part (Decew Member).

Most of the beds in the Lockport formation are described as "thick" (1 foot to 3 feet), or "thin" (1 inch to 1 foot); however, massive beds up to eight feet thick and very thin beds (1/4 to 1 inch) occassionally occur within the formation (Johnston, 1964). The bedding is normally straight, but some

curved bedding exists. Several extensive and open bedding joints exist throughout the Lockport Dolomite.

Clinton Group

The Clinton group immediately underlies the Lockport dolomite. According to Johnston (1964): "The Clinton rocks are composed principally of the dark-grey Rochester Shale at the top, but also contain two thin limestones (Irondequoit and Reynales) and a thin shale (Neagha) at the base".

La Sala (1968) reports the thickness of the Rochester shale as 60 feet.

Deeper Sedimentary Rock Formations

Additional series of sedimentary rock formations underlie the Clinton group and are briefly listed as follows:

Medina Group and Queenston Formation
Loraine Group
Trenton and Black River Groups
Theresa Formation

These groups/formations subsequently overlie the metamorphic basement rocks.

3.2 Local Geology

The Durez plant site and immediate vicinity have very little topographic relief. The U.S.G.S. Tonawanda East, N.Y. 15' Quadrangle (1980) is contoured at 5 foot intervals and shows only contours at 575' above mean sea level within a half mile radius of the plant site. A point elevation of 581 feet is given at the point where Walck Road crosses the Penn Central Railway line. The range of land surface elevations reported at

piezometer and well locations (Dunn Geoscience, 1983) are 98.56 feet at P-6 to 102.90 at P-11 with respect to Hooker datum (574.69 feet and 579.03 feet respectively above mean sea level).

The interpretations of the geology in the immediate Durez plant site are largely based upon borehole/well logs reported in Hooker (1980) and Occidental (1982).

3.2.1 Overburden

Figure 6 illustrates a representative geologic column for the Durez site. Figures 7, 8 and 9 illustrate the overburden stratigraphy. The figures are projections of sections A-A', B-B' and C-C' (shown on Figure 10) respectively, onto a plane parallel to Walck Road.

Fill and Topsoil

The fill was deposited in conjunction with plant site grading and ranges in thickness from 0 to 5 feet. Portions of the plant site to the north-west and south-east are void of fill material. The fill is composed principally of granular materials (sands and gravels). Some boreholes, however, revealed coal dust, ash and lesser amounts of industrial waste. The material was found to be in a loose to dense state and moist in nature. Topsoil is not always present and when found is generally less than 6 inches thick (Occidental, 1982). Asphalt and gravel pavement covers a large percentage of the central plant area.

Glaciolacustrine Silt

The glaciolacustrine silt is the uppermost naturally deposited stratigraphic unit and ranges in thickness from 2 to 5 feet. This glacial lake deposit is described as "brown

clayey silt, some fine sand" and "grey fine to medium sand, plus some clayey silt" (Occidental, 1982).

Standard penetration tests conducted during drilling indicate the material is generally loose near the surface, becoming compact to relatively dense with depth. Hooker (1980) states: "based solely on textural qualities, the glaciolacustrine silts probably exhibit hydraulic conductivities on the order of 10^{-6} cm/sec".

At the time of drilling, this silt unit was found to be either moist or frozen.

Fluvial Sands and Gravels

The fluvial sands and gravels were deposited during the Pleistocene Epoch as infill to stream channels eroded into the upper surface of the glaciolacustrine clays. There is evidence of at least one sand and gravel channel which runs in a general north-south direction across the centre of the site. The channel is, however, limited in lateral extent to several hundred feet. Figure 11 shows the thickness of the fluvial sands and gravels at piezometer locations. The thicknesses were extracted from logs in Hooker (1980) and Occidental (1982).

Hooker (1980) cites Freeze and Cherry (1979) in stating that: "the fluvial sands and gravels would have values of hydraulic conductivity several orders of magnitude greater than the (glaciolacustrine) silt". Occidental (1982) states "Hydraulic conductivity calculated from a bail test of well NP-11 was 4 x 10^{-4} cm/sec and is in close agreement with the values referenced in earlier work". Bail test data is not reproduced in Occidental (1982) nor is the method of data analysis specified. The screened interval of NP-11 is in

hydraulic connection with both glaciolacustrine silts and fluvial sands and gravels.

Glaciolacustrine Clay

The glaciolacustrine clay unit seems to be continuous over the site area. All well logs with geologic information report encountering the clay. Information is available for three piezometers (P-1, P-10 and P-17) and one deep well (W-17) which completely penetrate the clay unit. Clay thicknesses extracted from these logs indicate that the clay unit varies in thickness from 16.5 to 22.5 feet. The clay appears to be laminated (varved), containing thin layers of silt. The clay is very stiff to hard in the upper 6 feet but becomes soft and plastic in the lower parts of the unit.

Hooker (1980) reports the results of laboratory testing performed upon two Shelby tube samples of the glaciolacustrine clay at P-8 and P-18. The samples were taken from depths 13 - 15 feet below surface. The surface of the glaciolacustrine clay is 10 feet and 8 feet below surface at P-8 and P-18 respectively. Woodward Clyde Consultants performed the analysis. Analysis results are reported in Appendix E to Hooker (1980). Permeability test results are 1.6×10^{-8} cm/sec and 2.4×10^{-8} cm/sec for the P-8 and P-18 samples respectively. Grain size analysis noted that 100.0% of the P-8 sample and 99.3% of the P-18 sample passed on 200 mesh size screen.

Hooker (1980) suggests the possibility that the clay surface is an erosional surface and as such, was probably exposed to direct climatic influences at one time. Fractures in the clay are therefore a possibility, due to wet/dry and freeze/thaw cycles. If the clay is fractured, the bulk hydraulic conductivity may be considerably higher (possibly

several orders of magnitude) than that determined by the laboratory tests. There are no data available as to the existence and extent of fracturing in the glaciolacustrine clay at the Durez site.

A contour diagram was prepared showing the elevation of the surface of the glaciolacustrine clay (Figure 12). The elevation of the clay surface at piezometer locations was calculated by determining the depth below ground level of the clay surface, and subtracting this depth from the measured ground elevation at each piezometer. Clay surface depth data were extracted from those well logs in Hooker (1980) and Occidental (1982) which contain geologic information. For piezometers P-24 through P-27, P-29, and P-30, there are no geologic descriptions in the well log. For these piezometers clay depth was inferred from the depth of the bottom of the well screen. According to Hooker (1980) the piezometers were installed so that the bottom of the well screen was level with the top surface of the clay unit. Ground elevations are those reported by Dunn Geoscience (1983). Contours were generated using techniques described previously. The contours should be regarded as approximate only, due to the lack of resolution in the well log descriptions (i.e. most depths reported in the well logs are to the nearest half foot).

A large depression in the clay surface can be seen immediately north of Walck Road in the central plant area. The depression is centred on piezometer P-6.

Glacial Till

The till directly overlying the bedrock in the plant site area is a red-brown clayey silt and sand containing portions of gravel and cobbles. Available data indicates that the

thickness of the till varies between 1 and 7.5 feet in the plant vicinity.

3.2.2 Bedrock

Well logs for deep wells W-7, W-12, W-16 and W-17 (Hooker, 1980) report that these wells penetrate approximately 60 feet into the Camillus shale bedrock. La Sala (1968) estimates the Camillus shale to be 400 feet thick in the Erie-Niagara Basin. However, this is somewhat less where the formation subcrops (approximately 180 feet near the Durez site using the 40 foot/mile dip reported by La Sala, 1968). Occidental (1982) reports the Camillus to be from 50 to 70 feet in thickness in the North Tonawanda area.

Hooker (1980) reported the Camillus under the Durez plant site to be: "soft, dark gray dolomite to argillaceous limestone containing numerous calcite and gypsum zones representing fracture filling in the original rock. Thick gypsum beds described by La Sala (1968) were not encountered." Hooker (1980) notes the highly fractured nature of the bedrock and reports the presence of many solution cavities and zones.

4.0 HYDROGEOLOGY

4.1 Regional Hydrogeology

4.1.1 Unconsolidated Deposits

Unconsolidated deposits in the North Tonawanda area consist of relatively impermeable tills and clays with some silt units and intermittent sand and/or gravel lenses. Horizontal hydraulic gradients are generally quite low. The largest gradients are vertical, and directed downwards. Infiltration is a source of ground water recharge to the upper bedrock zone.

4.1.2 Bedrock Hydrogeology

In the Erie-Niagara Basin, groundwater is present in the bedding planes, fracture systems and dissolution features which have developed in the predominantly shale, limestone and dolomite units comprising the bedrock in the area. Within a hydrogeological context the geologic sequence, from uppermost to lowermost, may be interpreted as follows:

Camillus Shale	- relatively permeable
Lockport Dolomite	- relatively permeable
Rochester Shale	- relatively impermeable
	- confining unit.

The North Tonawanda area, and consequently the Durez plant site, are situated approximately in the middle of the subcrop zone (approximately 10.5 miles wide) for the Camillus shale. La Sala (1968) states that groundwater entering the Camillus shale discharges to Tonawanda Creek. A detailed discussion of all bedrock units and their hydrogeological properties is presented in La Sala (1968).

Generally, limestone and dolomite units yield higher quantities of water than shales. However, this is not true in the case of the Camillus shale. The Camillus shale contains gypsum layers interbedded and diffused within the shale. The gypsum units readily dissolve, creating dissolution features along the path of groundwater flow (i.e. along fractures and bedding plans).

The Camillus shale is comprised mainly of grey shale. However, in terms of hydrogeological properties, it is the gypsum, limestone and dolomite components of the unit which are most significant. In particular, the gypsum composition is most directly related to the formation's water bearing properties. When exposed to groundwater flow, gypsum beds dissolve, providing high yield channels for conveying groundwater. Transmissivities for the Camillus have been reported in the range of 7,000 to 70,000 US gpd/ft with yields of 90 to 1500 USGPM (La Sala, 1968) for wells penetrating a considerable thickness of the formation. It should be noted that some gypsum beds do remain intact due to lack of exposure to circulating groundwater.

Detailed groundwater flow patterns in the Camillus shale are indeterminant due to the lack of data available on piezometric elevations.

Although it is clear that a large-scale regional discharge point exists in the Tonawanda Creek area, the recharge area and source of groundwater potential is not apparent. Regional hydrogeological flow conceptualizations suggest recharge in upland areas 35 to 45 miles to the south/southeast with some deep flow lines discharging through the Camillus to the Tonawanda Creek area. This theory is supported by La Sala (1968).

The Camillus shale also receives some recharge from the underlying Lockport Dolomite (La Sala, 1968) as well as from the overlying unconsolidated deposits.

It may be possible, as with the Lockport Dolomite, that significant weathering of the bedrock occurred along the till/bedrock interface during exposure in glacial times. In the case of the Lockport Dolomite, the upper 15 feet was found to be significantly more fractured than underlying portions of the formation (Johnston, 1964). If this were to occur then the upper portion of the Camillus and other formations subcropping or outcropping in the Erie-Niagara area would likely have significant vertical hydraulic communication and enhanced water yielding properties. This is confirmed by La Sala (1968), who notes a zone of fracturing and solution extending several feet below the rock surface on a regional scale.

4.2 Local Hydrogeology

Local hydrogeology can be subdivided into three separate units:

- water table zone
- confining layer
- bedrock aquifer

4.2.1 Water Table Zone

The water table zone corresponds to the geologic interval consisting of those overburden materials which overly the glaciolacustrine clay. The water table surface recedes below the surface of the glaciolacustrine clay layer at some locations and times.

Prior to a discussion of hydrogeology in the water table zone, further background information is necessary. A discussion of

the sewer system in the vicinity of the plant site and presentation of water level elevation data follows.

4.2.1.1 Sewer System

The sewer system in the area of the Durez site is of some importance as a hydrogeologic influence and as a possible contaminant transport vector. The system can be reduced to two subsystems: the storm sewers, and the sanitary sewers.

Storm Sewers

The storm sewer system in the vicinity of the Durez site consists of three major components: a 4' x 5' boxed flume ("Pettit Creek Flume") which runs north - south along Nash Road, a 42 inch sewer (reduced to 30 inch east of the Penn Central Railway line) which runs east - west along Walck Road, and a 30 inch sewer which originates on the Durez plant property and runs west along Wilson Avenue until it intersects the boxed flume at Nash Road. The Walck Road sewer also connects to the boxed flume at Nash Road. In addition, a number of connections with sewers exiting the Durez site exist along both the Walck Road and Wilson Avenue sewers.

Figure 13 is a schematic description of the location and size of the storm sewer system components derived from maps supplied by the City of North Tonawanda (City of North Tonawanda, 1974a and City of North Tonawanda, 1974b). Connections into the plant area are shown as short stubs. The stub labelled "21 inch N", located west of the Penn Central Railroad tracks on Walck Road, was denoted "21 inch W" on the city map. This was interpreted as a labelling error on the map (City of North Tonawanda, 1974b) as the 42 inch line is the only line described as

east and west elsewhere along Walck Road. Given that all other connections along Walck Road lead into the Durez plant site, the 21 inch line was assigned a North direction. The City of North Tonawanda Engineering Department confirmed the labelling error and agreed that a north direction was most probable (David Maziarz, North Tonawanda City Engineering Dept., personal communication, 1983a).

The dashed line in the south-west corner of Figure 13 indicates a 12 inch sewer which is shown in plate 4.1 of the Occidental (1982) report. The location and type of this sewer does not match any connections indicated on City of N. Tonawanda (1974b). Given their proximity to each other (approximately 35 feet) and the fact that the city sewer map indicates no other manholes within a distance of 250 feet (City of N. Tonawanda, 1974b), the sewers marked 8"N on the city map and that referred to as 12" on plate 4.1 of Occidental (1982) may actually be the same. Location and description discrepancies may be the result of scaling and labelling errors on the part of Dunn Geoscience and/or the City of North Tonawanda.

With the exception of the 30 inch sewer paralleling Wilson Avenue and the 12 inch sewer indicated in Occidental (1982), there is no data available as to the precise location and size of sewer components on the plant property. However, Occidental (1982) states:

> "the central portion of the plant site is underlain by an extensive system of sewers". "These sewers are oriented primarily in a north-south direction and discharge into either the Wilson Avenue sewer or the Walck Road sewer."

Occidental (1982) also makes note of a sewer paralleling the Penn Central railroad tracks at the eastern plant boundary. The city map identifies a 15" stub paralleling the railroad at Walck Road. It is assumed that the sewer connected to this stub is the one identified in Occidental (1982) and that this sewer feeds into the Walck Road sewer.

Including the 12 inch sewer described in Occidental (1982), a total of eleven connections can be identified from which Durez wastewaters may enter the City sewer system. This total does not include the two stubs shown east of the Penn Central Railroad line on Walck Road. USEPA (1982) states that wastewaters are discharged through 14 outfalls to storm sewers.

Volume of flow into the storm sewers is not known. However, according to USEPA (1982) Durez Division obtains its water supply of 0.7 mgd from the City of North Tonawanda, and that with the exception of sanitary wastes, "all other wastewaters including cooling water, utility water, process wastes and stormwater runoff" are discharged to storm sewers. Although data pertaining to the amount of water retained in processes, lost through evaporation, and used for sanitary purposes, is not available, it is evident that the Durez facility discharges a subtantial volume into the sewer system. The number and size of stubs leading onto the plant site also support this conclusion.

Figure 14 depicts the invert elevations along the three main storm sewer components. Invert elevations shown at connections are the lowest elevation specified at the connection. Elevations are specified with respect to Hooker plant datum of 101.08 feet at Benchmark #2 (equals 577.21 feet with respect to USGS datum (Dunn Geoscience, 1983)). With the exception of the Walck Road sewer, all

elevations (relative to USGS datum) were acquired from City of North Tonawanda, 1974b map and subsequently converted to Hooker datum. Invert elevations of the 12 inch sewer shown on plate 4.1 (Occidental, 1982) are not available.

Enquiries to the City Engineering Department produced an updated set of invert elevations (David Maziarz, N. Tonawanda City Engineering Dept., personal communication, 1983c) for the Walck Road sewer. These elevations were converted to Hooker datum, and are those shown on Figure 14. According to the City Engineering Dept., the elevations are intended to reflect a 0.05% grade downward in a westerly direction.

Invert elevations for the boxed flume north of Wilson Avenue are somewhat misleading. The elevations indicate that flow is to the north in this area. The City Engineering Department believes that all flow along Nash Avenue in the boxed flume is to the south (David Maziarz, N. Tonawanda City Engineering Dept., personal communication, 1983b).

In summary, flow in the major storm sewer components is as follows:

- Wastewater in the 4' x 5' boxed flume flows southerly along Nash Road past the Durez site. South of the Nash/Walck intersection, the flume turns west and traverses the City. Wastewater is eventually discharged directly into the Tonawanda Channel of the Niagara River near the base of Wheatfield Street. Although sewer inverts north of Wilson Avenue suggest flow is north, these reflect minor deviations from the overall southerly sewer gradient.

- All flow in the 30 inch Wilson Avenue sewer is westerly to the point where the line joins the boxed flume at the intersection of Nash Road and Wilson Avenue.

- All flow in the Walck Road sewer east of Nash Road is westerly towards Nash Road. Flow is collected by the boxed flume at Nash Road.

Figure 15 shows the flow direction of the three sewers and the route of the boxed flume to its final discharge point.

Sanitary Sewer System

Information regarding the sanitary sewers has been extracted from City of N. Tonawanda, 1974b. A schematic diagram of the sanitary sewer system is shown in Figure 16. With the exception of the Erie Road sewer, the sanitary sewers are located in the centre of the roads. For this reason, most roads have not been drawn on Figure 16. Invert elevations (adjusted to Hooker datum) of the sanitary sewers are shown on Figure 17.

The primary component in the sanitary sewers is the line along Walck Road. Flow is westerly along the length of Walck Road. The sanitary sewers north of the plant (running along Wilson Avenue, Harding Avenue, Revere Avenue and Lee Avenue) flow in a westerly direction into the Nash Road Line. The Nash Road sewer flows south to Walck Road, where it drains into the Walck Road sewer. The portion of the Nash Road sewer south of Walck Road flows north into the Walck Road sewer.

The only known sanitary sewer entering the Durez property is the Wilson Avenue line. No other stubs or connections into Durez are indicated on City of N. Tonawanda, 1974b map. Given the size of the Durez facility, it is felt that more sanitary lines should be present. However, no data is available to indicate the size and location of any sanitary sewers other than those shown in Figure 16.

All waste collected in the sanitary sewer system is treated by the City of North Tonawanda and then discharged into the Niagara River.

Figure 18 illustrates the invert elevations of both sanitary and storm sewers overlain by the elevation contour for the surface of the glaciolacustrine clay. It can be seen that, in all locations where comparisons can be made, the storm sewers are located above the clay. On the other hand, the sanitary sewers are, for the most part, located beneath the clay surface. An exception can be seen at the extreme east end of Wilson Avenue where the sanitary sewer is located above the clay.

4.2.1.2 Water Level Elevations

When coupled with data regarding geologic and other influences, potentiometric surface elevation data are useful for conceptualizing ground water flow patterns. If data is available for a number of different times, the extent and effect of seasonal variations may also be assessed. From an ease of interpretation viewpoint, contour diagrams are the most suitable method for presenting potentiometric surface data. Through the use of an appropriate interpolation technique, points and contours corresponding to specified elevations can be approximated from the potentiometric surface elevations acquired at discrete spatial points.

The potentiometric surface of a hydrogeologic zone is defined at any point in time by the water level elevations measured in those piezometers with a screened interval in the same hydrogeologic zone. The potentiometric surface of the water table zone at the Durez site is therefore defined by elevation data acquired from those piezometers screened above the glaciolacustrine clay surface.

It is necessary to note that water level elevations may not be the actual elevation of the surface of the water table. This is due to the much higher permeability of the fluvial sands and gravels relative to the glaciolacustrine silt. If portions of the fluvial sands and gravels are subject to internal recharge (e.g., exfiltration from sewers or water mains located in the sands and gravels) then groundwater in the sands and gravels might exist under confined conditions. Water levels from piezometers screened in the sands and gravels would therefore reflect the head in the confined interval rather than the water table elevation. This would in no way compromise the usefulness of the data for determining flow directions.

A total of seven temporally discrete sets of water level data are available for the Durez site. Two data sets are derived from measurements taken by Dunn Geoscience personnel. Water level elevations calculated from this data were originally published as Table 5.2 of Section II of the Occidental (1982) report. Updated and corrected elevations are reported in Dunn Geoscience (1983). An additional five data sets were obtained from Appendix F of Hooker (1980).

Water level elevations for the five data sets reported in Hooker (1980) were recalculated using the reference point elevations reported in Dunn Geoscience (1983) and the depth to water data from Hooker (1980). Appendix I

contains the corrected water level elevation data for the seven data sets. In some cases, the piezometer was reported as dry. In these instances and where logs are available (piezometers P-1 through P-30, NP-1 through NP-11), the elevation of the bottom of the screened interval was assumed. The elevation of the bottom of the screened interval is the upper limit of water levels for the zone below the screened interval. These assumed data are of use in contouring for the purpose of establishing general trends but should not be used as absolute indicators of water level elevations.

Water level elevations for NP-3 were not used in preparation of the contour diagrams as NP-3 is screened in both the glaciolacustrine clay and the overlying sand unit (Occidental, 1982). The water level data in NP-3 is therefore indicative of a composite head in the clay confining layer rather than the water table zone.

Contour diagrams (Figures 19 through 24) for six of the seven data sets were generated as described previously. A contour map was not prepared for the Hooker (1980) data taken on the dates June 17, 1980 and June 18, 1980 due to insufficient data. Figure 25 shows the elevations at piezometer locations for these dates. In Figure 24, the contoured data included a number of dry piezometers, some of which have upper limiting elevations determined as discussed previously (bracketed values in Appendix I). These elevations were used to generate contour points. Contour lines drawn through these points have been noted with dashed lines. It should be stressed that the dashed contour lines do <u>not</u> indicate the exact position of the contour, but rather signify that a contour <u>does</u> exist in that general area. The actual position is of course dependent upon the actual water level elevation at the "dry" piezometer location on August 22, 1982.

4.2.1.3 Discussion

A preliminary conceptualization of the water table zone flow regime can be generated by using the water level contours as a primary data source. The conceptualization can then be modified by accounting for the effects of the local overburden geology and the sewer system.

Preliminary Conceptualization

All contour diagrams (Figures 19 through 24) show the existence of two groundwater highs, one in the vicinity of P-3 and P-18 on the west side of the Durez site, and the other in the locale of P-11. Figures 23 and 24 also indicate the existence of a third groundwater high south of Walck Road in the vicinity of NP-7, NP-8 and NP-9.

All data from Hooker (1980) measurements, and the Dunn Geoscience (1983) measurements from June 22, 1982 show P-18 as having the highest water level elevation. The Dunn Geoscience (1983) measurements taken on August 17, 1982 show P-3 as the highest measured water level elevation. Variations in the size and maximum elevation of the groundwater highs may be due to seasonal variation in precipitation, or may be caused by recharge conditions attributable to other causes, such as exfiltration from plant sewers.

Groundwater flow from the two main groundwater highs generally results in a pattern of offsite groundwater flow, at least in the west, south and east site perimeters.

Flow from an apparent ground water high south of Walck Road (Figures 23 and 24) appears to be north towards Walck Road.

Flow directions in the central area of the plant are difficult to determine from the water elevation contours due to the lack of data in this area.

Lack of data precludes making any definitive statements as to groundwater flow directions in the north east corner of the site. However, flow directions appear to be offsite towards Farnsworth Avenue and the Penn Central Railway. The north east plant area is susceptible to seasonal variations.

Elevation contours in the vicinity of piezometer P-6 may be affected by pumping operations at P-6. Occidental (1982) states the piezometer is pumped on a periodic basis in order to remove a separate phase of organics discovered at that well. The pumped fluids are properly disposed of off-site (Occidental, 1982). Data with regards to frequency of pumping and volume of fluid removed is not available. Therefore, contours in the area of P-6 may reflect a transient condition due to pumping activities, rather than seasonal variations.

Influence of Sewers

Some sewer influence on the water table zone flow regime is likely. In the vicinity of Walck Road, water level elevations show less temporal variation than in other areas. In addition, water level elevations along Walck Road are close to the storm sewer invert elevations. Figures 26 and 27 show water level elevation contours for June 22, 1982 and August 17, 1982 overlying the sewer invert elevations.

The groundwater elevation gradients immediately north of Walck Road indicate that the groundwater flow direction is southerly toward Walck Road. It appears that storm sewer infiltration and/or preferential drainage in the storm sewer bedding material is occurring. In the latter event, the bedding materials would act as a hydraulic sink, or

drain, in the area. The effect of the bedding materials upon groundwater flow is dependent on the groundwater elevations south of Walck Road. If elevations are higher south of Walck Road than in the sewer bedding, then flow from the area south of Walck Road will be north towards the sewer bedding. Flow direction is then along the bedding materials and is dictated by the gradient of the sewer bedding. If water level elevations south of Walck Road are less than the elevation in the sewer bedding, flow would be south from the sewer bedding in the direction of the gradient. For instance, the 93 foot elevation contour in Figure 27 along Walck Road indicates that the water table surface is lower than the sewer invert elevation, but nonetheless, is laterally aligned with the sewers. As the measured elevations in some piezometers south of Walck Road is less than 93 feet, it is evident that some southerly flow offsite does occur under certain conditions.

There are insufficient data to determine with certainty the effect of the Wilson Avenue storm sewer. However, the 95-foot contour line immediately north of the west groundwater high on Figure 26 is close to the sewer invert elevations, suggesting that portions of the Wilson Avenue sewer have similar effects to the Walck Road sewer.

It is difficult to assess the effect of the 12" sewer reported in Occidental (1982) (shown in Figures 26 and 27 as a dashed line in the western plant area). The sewer may be acting as a drain to westerly flow from the west groundwater high.

As no data are available with regard to the location and invert elevations of sewers located in the central plant site area, it is difficult to determine their effect upon flow in the water table zone. However, they are likely to be partially responsible for the depressed water levels in the central plant area. Occidental (1982) attributes the relative stability of water levels in the central area to the plant sewer system.

From the available data it is difficult to determine the effect, if any, of the sanitary sewer system on the water table zone flow regime.

Geologic Influences

There are two major geologic influences on water table groundwater flow at the Durez site.

The fluvial sands and gravels (Figure 11) act as a drain in the central plant area. The high permeability of this unit tends to create preferential groundwater flow. Consequently the bulk of groundwater volumetric flux from the east and west groundwater highs can be expected to flow through the fluvial sands and gravels towards the central plant area. From the central plant area, flow has both north and south direction. The exact location of the divide between northern and southerly flow cannot be determined exactly from the available data. All water level elevation contours indicate that flow in the central plant area south of P-7 is southerly in direction. A given volume of flow may be induced with a lower gradient in a high permeability unit as compared with a lower permeability unit. Therefore, the depressed groundwater elevations in the central plant area are likely partially due to the presence of the fluvial sands and gravels.

The surface of the glaciolacustrine clay also exhibits a certain degree of control over groundwater flow in the water table zone. However, the influence of the clay is opposite to that of the fluvial sands and gravels. The low permeability of the clay will serve to restrict and impede groundwater flow. In areas and at times where the water level surface recedes below the top of the clay surface,

flow volume will be substantially reduced. For example, the water level elevations for August 22, 1983 (Figure 27), indicate that the water table surface is lower than the glaciolacustrine clay surface at piezometers P-24 and P-25 (located at the west of the western groundwater high). Although a westerly gradient is present in the area, the volume of flow will be minimal as compared to that flowing east and south from the groundwater high. Similarly, flow volume in the north eastern plant area towards the Penn Central Railroad Line will be less than that occurring during periods when the water table surface is higher than the glaciolacustrine clay.

Other Influences

Building foundations which extend below the surface of the water table will have some impact on the local flow regime. The extent and magnitude of their impact will of course depend on the size, depth and material of the foundation. Foundations extending to the surface of the glaciolacustrine clay would have the effect of "curtains", around which flow will be diverted.

The composition and depth of the bedding material for the Penn Central Railway are unknown. However, it can be assumed that the bedding material is more permeable than the naturally deposited overburden geologic units. Flow into and along the railway bedding is thus to be expected. In particular, the railway bedding will act as a drain to the eastern groundwater high. The volumetric flux into the railway bedding, and the direction of flow in the bedding itself is difficult to determine with the available data.

4.2.2 Confining Layer

The glaciolacustrine clay is the hydrostratigraphic unit which separates the water table zone and the bedrock aquifer. Its

effectiveness as a barrier to hydraulic communication between the overlying and underlying zones is dependent upon its integrity. A number of conditions exist at the Durez site which may compromise the effectiveness of the confining layer. For the most part, these conditions are due to various construction activities which have either reduced the effective thickness of the glaciolacustrine clay unit, or may, according to some possible scenarios, allow direct hydraulic communication between the water table zone and the confined bedrock aquifer. The various conditions and scenarios will be dealt with briefly as follows:

- The methods of installation and completion of the documented eight deep wells formerly used for plant water supply are unknown. The integrity of the seal between the clay and the casing of these wells is therefore not known, and the possibility exists of leakage adjacent to the casing.

- The possible existence of a further eight deep wells raises the same concerns as for the documented wells. If the wells do in fact exist, the condition of the well casing is unknown. Casing leaks in the interval below ground surface and above the surface of the glaciolacustrine clay would allow direct hydraulic communication between the water table zone and the bedrock aquifer. Casing leaks below the surface of the clay would reduce the effective thickness of the clay at the well location.

- Fill materials used adjacent to building foundations are usually permeable in nature. Therefore, foundations that extend into the clay will reduce the effective thickness of the clay. The two smokestacks on the Durez property, depending on the foundation construction method used (i.e. piles driven to bedrock, or deep conventional foundations), may cause the entire thickness of the clay to be breached.

- The depth and composition of the bedding of the Penn Central Railroad tracks are not known. However, the bedding is most likely relatively permeable in nature. If the bedding extends into the clay the effective thickness of the clay will be reduced.

- With the exception of the most easterly segment of the Wilson Avenue sewer, the sanitary sewers are located below the clay surface. Assuming that backfill used subsequent to sewer installation is more permeable than the surrounding clay, the effective thickness of the clay is reduced in the immediate vicinity of the sanitary sewers.

It is recognized that the existence of many of the conditions described above is somewhat speculative as no confirmatory data are available. In addition, even if scenarios exist as described, their impact on flow patterns in the water table zone might well be minimal. However, they may be important when evaluated in the context of possible contaminant transport from the overburden to the bedrock aquifer.

4.2.3. Bedrock Aquifer

The hydrogeological properties of the Camillus shale at the Durez site are considered to be comparable to conditions discussed previously on a regional scale. Limited data are available from deep wells W-7, W-12, W-16 and W-17. Some data is also available from three wells listed by La Sala (1968) and located on the Durez property (see Table 8).

Water level measurements for the deep wells are available for four time periods. Hooker (1980) reports data for dates February 5, 1980, April 1 to 3, 1980 and June 16 and 17, 1980. Dunn Geoscience (1982) contains data for June 22nd, 1982. Water level elevations for Hooker (1980) data were calculated

using the procedure discussed in section 4.2.1.2. Appendix I contains water level measurement and elevation data. Figure 28 displays the data on a plant site representation.

The water levels, or piezometric elevations, obtained for these wells are representative of hydraulic head in the Camillus over a range of depths from 53 to 106 feet below land surface. Piezometric elevations obtained at the four wells are very close, which precludes determination of groundwater flow patterns in the area. However, bedrock groundwater flow directions are anticipated to be towards the Niagara River and Tonawanda Creek, which are probable regional groundwater discharge areas.

Yields of bedrock wells were reported by La Sala (1968) for the three wells on the Durez site which are documented in his report. One of these wells, which is cased from 0 to 42 feet and open to 105 feet deep, are capable of yielding 1200 gpm. The remaining two wells, which extend to 106 and 107 feet in depth, are capable of yielding 350 and 750 gpm respectively.

Vertical groundwater gradients are apparent when water levels in the unconsolidated deposits are compared to those in the bedrock (see Figures 19 to 25 and Figure 28). Assuming an average clay thickness of 20 feet and an average head difference of 8 feet, the average gradient across the clay is 0.25, directed downwards. Recharge rates to the bedrock aquifer through the clay are dependent on the hydraulic conductivity of the clay and till overlying the rock.

Groundwater quality in the water obtained from the Camillus is generally poor. The aquifer is suitable for industrial water supply, but not for potable water supply. Strong H_2S smells were noted during reconstruction of wells on the Durez site (Hooker, 1980). La Sala (1968) reports high concentrations of dissolved ions in wells on the Durez site.

5.0 CONTAMINATION

5.1 Contaminant Sources

Occidental (1982) states:

> "Past spillage and waste disposal from the Raschig phenol process, which was shut down in 1970, have resulted in the presence of benzene, toluene, chlorinated phenols and chlorinated benzenes in limited areas, primarily under the North Tonawanda plant site."

There is very little documentary evidence of waste disposal practices (both onsite and offsite) at the Durez plant prior to 1974. However, through employee interviews, Hooker was able to ascertain the existence and possible contents of fourteen waste disposal areas on the plant site. An estimated 28,500 tons of waste were landfilled in these areas over the period from prior to 1930 until approximately 1973 (ITF, 1978). Table 9 contains a breakdown of total estimated site contents on a tonnage basis. A brief description of the disposal sites follows (Hooker, 1978).

"SITE I Phenol tar was buried in this area. The phenol tar was put into drums and placed in an open excavation and covered periodically. This was used in the 1950's.

SITE II Hazardous and non-hazardous wastes were buried at this site to include phenol tar, phenolic resins and rubbish. Again, this site was used in the 1940's and 1950's.

SITE III This site was a "ring-washing" area for many years as well as a dumping area for spent catalyst.

SITE IV The phenol tar was "drummed of" in this area and on numerous occasions it was reported that these drums

overflowed. The residue seeped into the ground and there is evidence of tar surfacing at the present time.

SITE V This site is below the shipping room addition and is considered a burial site because it has been reported that various wastes, including phenol-bearing materials, were deposited as fill.

SITE VI This area was once a tank farm and overflowed on occasion. Styrene and liquid resin do exist in the sub surface areas here.

SITE VII This area was an open dump for many years. Waste liquids and solids are reportedly buried in this area. These include phenolic resins and molding compounds.

SITE VIII Rail cars that once contained phenol were rinsed in this area. The phenol wash was dumped on the ground and allowed to soak into the earth. This was a common practice for many years in the 1940's and 1950's.

SITE IX Throughout this area there is evidence of spent catalyst. It has been reported that much of the catalyst was buried at this location.

SITE X At one time this was an open dumping area. All types of rubbish and phenolic-bearing wastes are reportedly buried in this area.

SITE XI This site contains liquid resin that was probably buried sometime in the early 1950's. Evidence of leaching is apparent in the electrical manhole in this area.

SITE XII At the northern boundary of our property, a very large dumping site existed. All forms of waste were deposited in this area and it was reported that this site was used for many years. Phenolic resins, phenolic molding compounds and rubbish were eventually buried in this area.

SITE XIII This is the site of what was once known as the "fire hole." For years we burned our wastes and buried the remains in this area. Most of the waste was termed rubbish but there were reportings of drums of "off-spec" phenolic resin being buried here.

SITE XIV There is an unknown number of drums of scrap phenolic resin buried at this location. In addition, there is concrete overburden from our now non-existent phenol plant that covers this area."

Hooker (1978) also states that NYSDEC had tentatively approved a plan to "close" landfill areas site XIII and site XIV. Occidental (1982) reports that "in September 1979 two sites were excavated and removed for secure disposal offsite as part of NYSDEC approved closing plan."

Occidental (1982) states that "Tars which were produced in the Raschig process are buried in the southwest portion of the site." From the site descriptions, it appears that sites I, II and IV therefore contain Raschig tars. Occidental (1982) refers to the Raschig tars as being "the only process source of TCDD (tetrachlorodibenzo-p-dioxin)."

In addition to the fourteen sites described above, another eight possible disposal areas were identified on the basis of well log descriptions. The locations and relevant descriptions are summarized below. Descriptions for borings P-8, P-13, P-15, P-16, P-18 and P-20 are from Hooker (1980). Descriptions for borings P-26 and NP-3 are from Occidental (1982).

Boring P-8 - "Industrial waste: slag, cinders, brick fragments, pink chemical"
- located at depths 1' - 6'

Boring P-13 - "Gravel, ash, possible industrial waste"
- located at depths 1' - 3'

Boring P-15 - "Gravel, cinders, industrial waste"
- located at depths 0' - 3'

Boring P-16 - "mF Gravel saturated with oil?"
- located at depths 0'- 2'

Boring P-18 - "Gravel, black, oily"
- located at depths 0' - 2'

Boring P-20 - "Topsoil on FILL: industrial waste, cinders"
- located at depths 0' -2'

Boring P-26 - "Unidentified chemical contamination"
- located at depths 3.7' - 5.5'

Boring NP-3 - "Black due to possible contamination?"
- located at depths 2.5' - 4'

Figure 29 shows the location of both the sites identified in the Hooker memorandum and the possible sites described above. Hooker sites are designated with Roman numerals corresponding to the site description. Possible waste sites are identified by the numeric part (8, 13, 15, 16, 18, 20, 26, 3) of the boring designation. The areal extent of each site identified by Hooker (1978) (shown on Figure 29) are derived from Figure 1.1 of section III of Occidental (1982). The dashed circles enclosing the possible waste site designation are not an indication of areal extent but rather serve to note location.

Site 15 is the only possible waste site in the vicinity of an identified disposal site (Site X). All other possible waste sites are clearly separate from the disposal sites identified by Hooker.

5.2 Water Table Zone Contamination

A discussion of contamination in the water table zone will follow presentation of analytical data in two segments; piezometer sampling results, and storm sewer sampling results. Discussion of TCDD contamination will be reserved until section 5.5 of this report.

5.2.1 Piezometer Sampling Results

Results of the analysis of water samples obtained from piezometers were available from three sources: Hooker (1980),

Occidental (1982) and NYSDEC (1982a). These data have been compiled and are provided in Appendix IIa.

Hooker (1980) data consists of selected analyses on samples taken from most of piezometers P-1 through P-30. Samples from P-6 were not analyzed as the samples contained no aqueous phase and were thus inappropriate for the selected analysis methodology. P-18 was not sampled, as the well would not recharge adequately to meet the specified sampling protocol requirements.

Occidental (1982) and NYSDEC (1982a) data are the results of separate analyses performed upon split samples. Sampling was attempted on piezometers NP-1 through NP-11 (with the exception of NP-3) and selected piezometers from the series P-1 through P-36. Piezometers NP-1, NP-5, P-21 and P-36 were dry on the date of sampling. There is good agreement between analytical results for the two sources.

Figures 30 through 33 are plan distributions of contaminant concentrations from analysis results for phenols, mono-chlorobenzene, p-dichlorobenzene and toluene respectively. These particular contaminants were selected as they are indicative of the general state of contamination suggested by the analytic results.

Single point numbers were obtained by averaging the data for all analyses available at each piezometer location. Analyses which resulted in no detection at a specified concentration were included in the averages as 0 values. Although this representation does not allow evaluation of temporal variation, it serves to indicate zones of contamination.

It should be noted that including zero values in the point averages may yield calculated values less than the detection limit. In cases where this occurs, it can be assumed that at

least one sample analysis produced detectable concentrations of the contaminant in question.

In some cases different detection limits were available from the different data sources. If a contaminant was not detected at a piezometer, the lowest detection limit available for the contaminant at the specific piezometer is shown. Due to the non-overlapping nature of the data base, different detection limits may be shown on the same figure at different piezometer locations.

5.2.2. Sewer Sampling Results

Analytical results of samples taken from the storm sewer system have been compiled and are presented in Appendix IIb.

Sampling points from which Hooker (1980) samples were taken are denoted SS-1 through SS-10. Locations of the sampling points are shown in figure 34. Sampling point SS-1 is not actually a sewer sampling point. Hooker (1980) states that: "SS-1 is located in the drainage ditch to the east of the railroad tracks."

Sampling points from which NYSDEC (1982b) and Occidental (1982) samples were taken are denoted 4R, 6A, 6B, 6K and Nash/Walck. Locations are shown in Figure 35.

Sewer sampling points 4R (Figure 35) and SS-10 (Figure 34) are coincident. Similarly, sampling points 6K and SS-6 may be coincident, depending upon the actual location and type of sewer connections in this area (as discussed in section 4.2.1.1.).

Figures 36 through 39, are plan distributions of contaminant concentrations for phenols, monochlorobenzene, p-dichlorobenzene and toluene respectively. Distributions are

temporal averages determined as discussed previously. Values for 4R and SS-10 have been averaged as have values for 6K and SS-6.

5.2.3 Discussion

Examination of the Figures 30 through 33 indicate that contaminant distributions are very heterogenous over the site area. Furthermore, the severity of contamination according to specific contaminants varies. (Note: "severity" of contamination is considered in the context of concentration levels relative to those exhibited elsewhere throughout the site.) For example, at piezometer P-3, monochlorobenzene contamination is very severe, p-dichlorobenzene contamination is severe, phenol contamination is moderate, and toluene contamination is nonexistant. At piezometer P-26 monochlorobenzene contamination is low, p-dichlorobenzene contamination is low, phenol contamination is high, and toluene contamination is very severe. This variation is probably due to the different mix of waste and waste types among the contaminant sources.

However, some general observations can be made with specific reference to Figures 30 through 33 and Figures 36 through 39. They are as follows:

- There is no evidence of contamination south of Walck Road. Two scenarios may account for this. Infiltration into the storm sewers and/or storm sewer bedding may be curtailing transport. Alternatively, dense contaminants, migrating under gravity control along the surface of the glaciolacustrine clay, may be sinking into the relatively permeable "trench" formed by backfill materials above the sanitary sewers in the centre of Walck Road.

- There is no evidence of contamination north of the Wilson Avenue sewer lines. Scenarios similar to those detailed above are equally valid in this case.

- There is indication of relatively minor amounts of contamination in the northeast plant area. Given the south easterly groundwater flow direction, contaminants in this area may be infiltrating the railway bedding and/or the storm sewer described in Occidental (1982) as being parallel to the railway.

- There is indication of low to very low contamination in the north plant area between the Niagara-Mohawk Power Corridor and Farnsworth Avenue. Apart from very low phenol concentrations at P-16, P-17 and P-27, and a similarly low detection of p-dichlorobenzene at P-17, little evidence of contamination exists.

- There is evidence of some contamination in the extreme western plant area. However, the contamination is substantially less than that seen a short distance east. Assuming that flow is westerly in this area, it appears that a certain amount of infiltration into the twelve inch sewer and/or sewer bedding is occurring and is responsible for curtailing contaminant migration offsite to the west.

- Severe contamination exists in the east central plant area in the vicinity of P-11 (the east groundwater high). According to the flow scenario developed in section 4.2.1.3, a portion of this contamination can be expected to be transported southeast towards the Penn Central Railroad. Transport towards the central plant area is also expected through the fluvial sands and gravels.

- Severe contamination is consistently indicated in the central plant area in the vicinity of P-7. This piezometer is located in the centre of a transport "channel" described by the glaciolacustrine clay surface and the fluvial sands and gravels. Consequently, contaminants moving under gravity control towards the clay surface depression at P-6 are likely to be prevalent in this area.

- Severe contamination exists in the western plant area in the vicinity of P-1 and P-3 (the west groundwater high). Indeed, the monochlorobenzene concentration at P-3 is extremely high. Contamination is expected to be transported radially from this area. However, as noted previously, flow to the west seems to be curtailed by the twelve inch sewer. No piezometer exists directly north of P-3, and therefore data are unavailable to assess the influence of either the Wilson Avenue sewers or the westerly oriented leg of the twelve inch onsite storm sewer.

- The presence of a separate phase of organics at P-6 illustrates the importance of gravity control as a transport mechanism. Dense organics have filled the localized depression in the clay surface in this area.

Sewer sampling results are consistent with that expected for the Walck Road sewer. For those constituents shown in Figures 36 through 39, and for which analyses returned detectable concentrations, it can be seen that concentrations increase steadily in the direction of sewer flow (westerly). The incremental increase in sewer loading may be attributed to contaminated process wastes and/or infiltration of contaminated groundwater.

Detected contaminant concentrations in the Wilson Avenue sewer appear to decrease in the direction of flow up to sewer sampling point 4R (SS-10). At this point an increase is noted. The reduction in concentrations west of this point may be due to dilution by relatively uncontaminated process wastes and/or infiltration of similarly uncontaminated groundwater.

Durez is legally allowed to discharge a certain quantity of contaminants into the sewer system under the terms of its current State Pollutant Discharge Elimination System (SPDES) permit. The SPDES permit for the period October 1, 1979 to March 31, 1981, which was subsequently extended and is currently applicable, allows 35 lbs/day phenolic compounds, 2.9 lbs/day benzene, 0.1 lbs/day toluene, 7.5 lbs/day monochlorobenzene, 6.0 lbs/day dichlorobenzene and 0.2 lbs/day of trichlorobenzene to be discharged to the storm sewers (NYSDEC, 1979). Occidental (1982) states that "levels discharged in sewers are considerably lower than the SPDES permit allows."

In the context of impact upon Niagara River water quality, it is storm sewer contamination which is of most concern. All wastes entering the storm sewer system are discharged directly to the Niagara River. To ameliorate adverse impact it is necessary to identify and remediate sources of storm sewer contamination at the Durez site.

It is not clear as to the precise source(s) of sewer loadings. Some percentage of the phenol contamination can be attributed to current process wastewater. All other contamination is a result of sewer infiltration by contaminated groundwater. Point(s) of infiltration cannot be determined with the available data. A detailed flow and chemical balance analysis of the sewer system, both onsite and offsite, is necessary to determine the sources of contaminant infiltration.

5.3 Confining Layer Contamination

There are no monitoring facilities available to determine the severity and extent of contamination, if any, in the glaciolacustrine clay.

As discussed in previous sections, the possibility exists of various conditions which may lead to contaminants migrating through the clay. These conditions include the various breachment or impairment scenarios hypothesized in sections 4.2.2 and the possibility that the clay permeability may be higher than indicated by laboratory testing results. The downward hydraulic gradient across the clay, the known existence of contaminants in contact with the clay, and the propensity of these contaminants to migrate under gravity control all indicate that contaminant transport through the clay is a possibility.

The mechanisms and importance of chemical migration processes for the transport of organics through the clay has not been assessed. However, it is possible that chemical migration processes may enhance the capability of organic transport through the glaciolacustrine clay unit.

The installation of monitoring facilities in the clay would allow a quantitative assessment of contamination in this zone.

5.4 Bedrock Aquifer Contamination

Contamination of the bedrock aquifer has been monitored in the past by sampling groundwater from deep wells (W-7, W-12, W-16, W-17). Analysis results have been compiled and are presented in Appendix IIc. Plan representations of averaged concentration distributions for selected contaminants are presented in Figures 40 to 43.

The data indicate low levels of organic contamination in all four wells. Benzene, toluene, phenols, monochlorobenzene, and 1,2,4-trichlorobenzene have been detected in the ug/litre range in groundwater from these wells. Data was also collected for chlorides, TDS, pH and specific conductance. This data, although high in magnitude, is typical of groundwater from the Camillus shale on an aquifer wide basis. Samples from the bedrock wells represent a composite of groundwater over the entire section of the open boreholes (see Table 4) as well as from other zones, either above or below, which are in hydraulic connection with each borehole. The measured contamination at the deep wells may understate the contamination in the upper region of the aquifer due to dilution by relatively uncontaminated groundwater from the lower region of the sampling interval. Analytical results for the bedrock cannot be considered to be representative of the upper several feet of the Camillus, a zone known to exhibit fracturing and dissolution. The depth of the sampling interval below the surface of the bedrock (see Table 6) precludes effective sampling from this zone. Contamination entering this zone may be transported horizontally within the aquifer, and therefore might not be detected by the existing monitoring facilities.

The route by which detected contaminants entered the bedrock aquifer is not clear. It is possible that contaminants are present due to drilling operations. However, this is not likely as groundwater analysis conducted in 1982 generally detected more contamination than did the 1980 samples obtained several months after drilling. In addition, Hooker (1980) detailed measures taken to avoid such an occurrence.

Abandoned bedrock wells which may exist on the Durez site are a possible avenue of migration. Well logs and locations are not available, but it is possible that construction techniques or lack of well maintenance may result in contaminant transport into the bedrock via the abandoned wells.

Other possible routes include migration along backfill areas for building foundations which may fully or partially penetrate the glaciolacustrine clay. Sufficient data on facility design is not available to allow evaluation of this possibility.

The final possible migration route is through the clay itself.

Bedrock contamination does not seem to present an immediate problem. However, as Tonawanda Creek and the Niagara River are likely discharge points for Camillus shale groundwater, the possibility exists for long term impact on Niagara River water quality from bedrock contamination existing at the Durez site.

5.5 TCDD Contamination

In 1979, Occidental chemists theorized that tetrachlorodibenzo-p-dioxins (TCDD) may have been byproducts of the Raschig phenol process, and may be present in phenol tar waste from that process. In 1979, an analysis of a Raschig tar sample for TCDD was performed and positive results were returned (Occidental 1982). Consequently, TCDD sampling and analysis were performed as part of the work described in Occidental (1982). Analyses were performed upon soil borings obtained during the installation of piezometers NP-1 through NP-11, additional soil borings taken adjacent to previously installed piezometers, and water samples from storm sewers. TCDD analysis results for soil boring data and sewer samples are presented in Appendix IId. Plan representations of soil boring analysis results for TCDD and 2,3,7,8-TCDD (and co-eluting isomers) are shown in Figures 44, and 45 respectively. Analysis results of sewer samples for TCDD and 2,3,7,8-TCDD (and co-eluting isomers) are shown in Figures 46 and 47 respectively. Single point values are averages determined as discussed previously.

TCDD in soil was detected at two locations onsite and three locations offsite. However, according to Occidental (1982), the isomer distribution of the positive results indicated that in only one location (NP-3) can the TCDD be attributed to Durez waste disposal activities. All other positive analyses showed isomer distributions which are dissimilar to those expected from TCDD associated with Raschig process phenol tar wastes. Occidental (1982) states:

> "We speculate that since the isomers found occur in such things as municipal sewage sludge and flyash material, the TCDD may have been carried to the site as fill."

Occidental (1982) indicates that TCDD is essentially insoluble in water, and must be dissolved in other organic chemicals in order to be transported. The presence of other organics was not detected at NP-3, and therefore TCDD is unlikely be transported from the area.

TCDD was detected in one analysis of the sewer sample taken at the 4R sampling location on Wilson Avenue. No other sewer samples were found to contain TCDD.

6.0 CONCLUSIONS

Interpretation of the available hydrogeologic data on the Durez plant site resulted in the following conclusions, which are considered to be relevant to Niagara River water quality.

Conclusions are broken into three main areas for discussion purposes. These are:

1) unconsolidated deposits,
2) sewers and other utilities, and
3) bedrock.

6.1 Unconsolidated Deposits

- Dissolved organic contaminants have been detected in the local groundwater regime at the Durez site in the stratigraphic units above the clay. With the exception of phenols, all contaminants detected are due to past on-site waste disposal activities. Phenol contamination may be due to exfiltration from sewers of current process wastewater and/or past waste disposal activities. Contaminant data are available mostly for on-site piezometers. Some data are available from a limited number of off-site piezometers located south of Walck Road. A number of other off-site piezometers have recently been installed. However, data from these piezometers have not yet been released.

- The extent of off-site migration of contaminants at the Durez site is for the most part unknown. Available data indicates that no contamination exists south of Walck Road between Nash Road and the Penn Central Railroad line. However, conceptualizations of the groundwater flow regime based on water level data indicate that the

possibility of southerly transport exists under certain seasonally varying conditions. These conditions occur when the water level elevation is lower than the sewer invert elevation. The extent of migration east of the plant is indeterminate due to lack of data beyond the eastern plant-site boundary. Similarly, a lack of data precludes specification of migration to the north and west of the plant site.

- Non-continuous glaciofluvial sand and gravel deposits through the central site area appear to be the most permeable overburden deposits and as such are considered to be a major route of contaminant transport in the unconsolidated deposits. Representative hydraulic parameters of the sands and gravels, and of other surficial deposits, have not been adequately determined with in-situ testing procedures.

- Conditions exist which are favourable for contaminant migration through the glaciolacustrine clay to the bedrock aquifer. The rate of migration is dependent upon the hydraulic characteristics and integrity of the clay and the chemical processes occurring between the clay and the organic compounds. The extent of contamination in the clay has not been addressed in current monitoring programs. The hydraulic parameters of the clay have similarly not been adequately addressed to date.

6.2 Sewers and Other Utilities

- Storm sewer water is not treated prior to discharge to the Niagara River. Wastewater discharge to the storm sewers is a source of phenol loading to the Niagara River. Infiltration of contaminated groundwater into the storm sewer system is the source of other organic chemical loading to the Niagara River originating from the Durez site. Infiltration may be occurring on site

to the plant sewer system. Water level elevations in the vicinity of Walck Road imply that infiltration to the storm sewers and/or the storm sewer bedding material is occurring.

- All contaminant loading to the storm sewer system is within the limits specified by the SPDES permit for the Durez facility.

- The extent of contamination in the sanitary sewer system is unknown. No water samples from the sanitary sewers have been analyzed. If infiltration is occurring its effects upon Niagara River water quality will be ameliorated as sanitary sewer water is treated prior to discharge.

- Sewer trench backfill, as well as other utility trench backfill, is likely of higher hydraulic conductivity than the natural geologic deposits and may act as preferred contaminant transport channels.

- Data (location, etc.) on both storm sewers and sanitary sewers which are located within the plant site boundaries are extremely limited. Consequently, the effects of these sewers on contaminant transport cannot be assessed.

6.3 Bedrock

- Groundwater gradients, from the unconsolidated deposits above the clay to the bedrock, are directed downward with a magnitude of about 0.25.

- The existing bedrock wells indicate very low horizontal gradients. Flow direction cannot be determined with the available data. Based on a regional hydrogeologic flow

interpretation, the likely discharge areas of the Camillus shale are Tonawanda Creek and/or the Niagara River.

- Contaminant concentrations measured in the bedrock are low compared to those measured in the overburden. Routes of contamination from the surficial zone to the bedrock may include abandoned water supply wells, building foundation backfill, and bedding materials. Transport through the clay itself may also be occurring.

- The existing bedrock monitoring system does not represent conditions in the more permeable upper zone of the bedrock. Any contamination reaching the bedrock may be conveyed laterally through this zone. The existing monitoring wells may not be located at sufficiently shallow depths in the bedrock to detect the principal zone of contamination.

7.0 RECOMMENDATIONS

7.1 Unconsolidated Deposits

The following recommendations are presented to aid in reducing some of the existing uncertainty and to provide a better understanding of groundwater flow and contaminant transport in unconsolidated deposits at the Durez site.

- Expand the monitoring system to determine the extent and nature of offsite ground water flow. Chemical concentration data at these locations are required to delineate the zone of contamination.

- Conduct appropriate in-situ hydraulic testing (i.e., slug tests, pump tests) in order to establish representative bulk hydraulic conductivities for all unconsolidated deposits (clay, till, silt, sand and gravel).

- Excavate to and examine the surface of the clay in a relatively uncontaminated portion of the site. The objective would be to determine the existence and depth of vertical fractures in the clay unit and the resultant effect these fractures have on the hydraulic conductivity of the clay.

- Install piezometer nests at several points throughout the unconsolidated deposits in order to determine vertical hydraulic gradients and the vertical distribution of contaminants in the unconsolidated deposits. This information will enable the determination of migration, if any, through the clay.

7.2 Sewers and Other Utilities

It is apparent that the buried Durez plant site services (i.e., sewers) and/or associated trenching operations affect the water

table flow regime and may affect the bedrock flow regime. The existence and extent of these effects is not known at this time due to the lack of data. The following further investigations are recommended to establish what effects exist:

- Identify the plant site sewer systems, both storm and sanitary, along with the type of bedding materials used.

- Identify other plant site services that may impact the groundwater regime. This includes water mains, water main bedding material, gas mains, and other buried utilities.

- Install piezometers along the sections of sewers where infiltration is suspected. Locally depressed water levels would imply infiltration. If infiltration is apparent, the water levels will enable the calculation of hydraulic gradients which, in conjunction with concentration data, can be used to estimate contaminant flux toward the sewers.

- Conduct an in-depth study of the flows and contaminant loading to the storm sewers. Flows and loadings can be compared to process discharges to the sewers, leaving the difference attributable to groundwater infiltration/exfiltration or unidentified sewer connections. A TV survey of the sewers would assist in locating previously unidentified connections. Contamination levels should also be monitored in the sanitary sewers to identify if infiltration is occurring.

7.3 Bedrock

- Locate and establish the integrity of all abandoned wells. These wells may require reconstruction or sealing to prevent contaminant migration to the bedrock.

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- Install bedrock wells screened in the upper fractured and dissolution zone of the Camillus shale. These wells could be used to establish the concentrations of contaminants in the upper portion of the Camillus shale as well as to provide a better indication of potentiometric elevations and consequently flow directions in the bedrock.

- Assess the possibility of contaminant transport along building foundations and backfill zones.

- Assess the effect of sewers that partially penetrate the clay layer in regard to migration potential to the bedrock. This investigation overlaps the study of the sewer system proposed in 7.2 and could be determined based on sewer flow balances.

Recommendations regarding remedial measures are considered somewhat premature based on the data available. Remediation alternatives can be more effectively evaluated following implementation of a more detailed field investigation and interpretation program.

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TABLE 1. Ground Elevation Discrepancies

Piezometer/ Well	Dunn Geoscience (1983) (feet)	Hooker (1980) (feet)	Hooker + 1 (1980) (feet)	Difference (feet)
P-1	99.13	98.30	99.30	-0.17
P-2	99.25	98.30	99.30	-0.05
P-3	99.69	98.70	99.70	-0.01
P-4	99.31	98.50	99.50	-0.19
P-5	99.45	98.70	99.70	-0.25
P-6	98.56	97.90	98.90	-0.34
P-7	98.95	98.00	99.00	-0.05
P-8	102.03	101.00	102.00	+0.03
P-9	101.07	99.80	100.80	+0.27
P-10	102.26	101.70	102.70	-0.44
P-11	102.90	101.40	102.40	+0.50
P-12	101.94	101.20	102.20	-0.26
P-13	100.80	99.90	100.90	-0.10
P-14	101.89	101.00	102.00	-0.11
P-15	100.23	99.30	100.30	-0.07
P-16	99.01	98.10	99.10	-0.09
P-17	99.89	98.40	99.40	+0.49
P-18	99.99	99.10	100.10	-0.11
P-19	101.31	101.20	102.20	-0.89
P-20	100.45	99.80	100.80	-0.35
P-21	98.41	98.30	99.30	-0.89
P-22	---	---	---	---
P-23	99.82	98.70	99.70	+0.12
P-24	99.29	98.30	99.30	-0.01
P-25	99.19	98.20	99.20	-0.01
P-26	101.46	100.50	101.50	-0.04
P-27	100.26	98.70	99.70	+0.56
P-28	---	---	---	---
P-29	98.56	98.40	99.40	-0.84
P-30	101.20	100.10	101.10	+0.10
W-7	101.01	100.00	101.00	+0.01
W-12	99.59	98.60	99.60	-0.01
W-16	99.67	97.90	98.90	+0.77
W-17	98.96	98.10	99.10	-0.14

TABLE 2. Measuring Point Elevation Discrepancies

Piezometer/ Well	Dunn Geoscience (1983) (feet)	Hooker (1980) (feet)	Hooker + 1 (1980) (feet)	Difference (feet)
P-1	101.84	100.58	101.58	+0.26
P-2	101.38	100.32	101.32	+0.06
P-3	101.69	100.68	101.68	+0.01
P-4	101.23	100.20	101.20	+0.03
P-5	101.58	100.58	101.58	0.00
P-6	100.73	99.73	100.73	0.00
P-7	100.74	99.66	100.66	+0.08
P-8	103.95	102.95	103.95	0.00
P-9	102.65	102.03	103.03	-0.38
P-10	103.18	102.60	103.60	-0.42
P-11	104.15	103.17	104.17	-0.02
P-12	104.19	103.56	104.56	-0.37
P-13	102.76	101.94	102.94	-0.18
P-14	103.72	103.11	104.11	-0.39
P-15	102.48	101.86	102.86	-0.38
P-16	101.09	100.10	101.10	-0.01
P-17	101.47	100.44	101.44	+0.03
P-18	101.82	100.81	101.81	+0.01
P-19	103.73	102.72	103.72	+0.01
P-20	102.20	101.60	102.60	-0.40
P-21	100.58	100.53	101.53	-0.95
P-22	---	---	---	---
P-23	102.61	101.49	102.49	+0.12
P-24	101.12	100.12	101.12	0.00
P-25	101.69	100.64	101.64	+0.05
P-26	102.71	101.72	102.72	-0.01
P-27	101.89	100.93	101.93	-0.04
P-28	---	---	---	---
P-29	101.98	101.83	102.83	-0.85
P-30	103.20	102.11	103.11	+0.09
W-7	104.51	103.34	104.34	+0.17
W-12	102.80	101.63	102.63	+0.17
W-16	103.92	102.85	103.85	+0.07
W-17	101.38	100.23	101.23	+0.15

TABLE 3. Shallow Piezometer Descriptions

Piezometer	Ground Elevation	Date Installed	Comments
P-1	99.13	12/26/79 12/27/79	Installed adjacent to exploratory boring which was drilled to bedrock and then grouted to surface. Sample dated 4/4/80 shows pH 8.9. Sample dated 6/18/80 shows pH 7.68. Well log indicates screen is located 6" above clay surface.
P-2	99.25	12/14/79	---
P-3	99.69	12/19/79	Sample dated 4/4/80 shows pH 9.8. Sample dated 6/17/80 shows pH 7.99.
P-4	99.31	12/13/79 12/14/79	---
P-5	99.45	12/13/79	Sample dated 4/2/80 shows pH 12.46. Sample dated 6/18/80 shows pH 12.37.
P-6	98.56	12/12/79	no pH analysis available (no aqueous phase in sample, i.e. sample consisted wholly of liquid organics)
P-7	98.95	12/17/79	---
P-8	102.03	12/20/79	---
P-9	101.07	12/28/79	---
P-10	102.26	12/27/79 12/28/79	Installed adjacent to exploratory boring which was drilled to bedrock and then grouted to surface.
P-11	102.90	12/20/79	---
P-12	101.94	12/18/79	---
P-13	100.80	12/20/79	---
P-14	101.89	12/18/79	Sample dated 4/2/80 shows pH 12.34. Sample dated 6/18/80 shows pH 12.04

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Piezometer	Ground Elevation	Date Installed	Comments
P-15	100.23	12/21/79	---
P-16	99.01	1/8/80	Sample dated 4/2/80 shows pH 12.57. Sample dated 6/17/80 shows field pH 11.90.
P-17	99.89	1/7/80 1/8/80	According to text (Hooker, 1980) piezometer was installed adjacent to exploratory boring to bed-rock. According to well log piezometer might be installed in exploratory boring. Sample dated 4/2/80 shows pH 12.49. Sample dated 6/17/80 shows field pH 12.10.
P-18	99.99	1/2/80	No pH data available (well would not recharge sufficiently for sampling).
P-19	101.31	12/19/79	---
P-20	100.45	1/2/80	---
P-21	98.41	1/9/80	Geologic information in Hooker (1980) and Occidental (1982).
P-22	--	1/9/80	Well was damaged subsequent to 6/17/80.
P-23	99.82	1/9/80	---
P-24	99.29	12/14/79	Replacement for old well point. No geologic information in well log.
P-25	99.19	12/19/79	See comments for P-24.
P-26	101.46	12/28/79	Replacement for old well point. Geologic information in Occidental (1982).
P-27	100.26	1/3/80	See comments for P-24.

Piezometer	Ground Elevation	Date Installed	Comments
P-28	--	1/4/80	Replacement for old well point. Abandoned subsequent to 6/18/80. Replaced by NP-11.
P-29	98.56	1/4/80	Replacement for old well point. Geologic information in Occidental (1982).
P-30	101.20	1/4/80	Replacement for old well point. No geologic information on well log.
P-31	100.09	Nov. 81	No pH data available. No geologic information available.
P-32	--	Nov. 81	Bent subsequent to 6/17/80. No geolgoic information avaiable.
P-33	99.34	Nov. 81	Geologic information in Occidental (1982).
P-34	98.89	Nov. 81	See comments for P-33.
P-35	98.59	Nov. 81	No pH data available. No geologic information available.
P-36	98.98	Nov. 81	No pH data available. Geologic information in Occidental (1982).
SWP-7	--	Nov. 81	No pH data available. Installed in sewer bedding of Walck Road sewer. No geologic information avaiable.
SWP-8	--	Nov. 81	See comments for SWP-7.
SWP-9	100.23	Nov. 81	No pH data available. Installed in sewer bedding of Wilson Avenue sewer. No geologic information available.

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Piezometer	Ground Elevation	Date Installed	Comments
NP-1	98.93	5/26/82 5/27/82	No pH data available - Well dry on sampling.
NP-2	99.48	6/3/82	---
NP-3	101.48	5/27/82	Well screen set in clay and small (.25 ft) sand and silt lens. No pH data available.
NP-4	99.12	6/2/82	---
NP-5	99.79	6/4/82	No pH data available - well dry on sampling.
NP-6	99.57	6/2/82	---
NP-7	99.14	6/1/82	---
NP-8	99.21	6/1/82	---
NP-9	99.75	6/1/82	---
NP-10	101.53	5/28/82	---
NP-11	99.97	6/3/82	Replacement for abandoned piezometer P-28

TABLE 4. Deep Well Sampling Intervals

Well	Ground Elevation (feet)	Top of Sampling Interval Depth (feet)	Top of Sampling Interval Elevation (feet)	Bottom of Sampling Interval Depth (feet)	Bottom of Sampling Interval Elevation (feet)	Length of Sampling Interval (feet)
W-7	101.01	59	42.01	100	1.01	41
W-12	99.59	65	34.59	106	-6.41	41
W-16	99.67	65	34.67	105	-5.33	40
W-17	98.96	53	45.96	100	-1.04	47

Elevations are with reference to Hooker Benchmark #2 at 101.08 feet

TABLE 5. Bedrock Elevations

Well/Piezometer	Ground Elevation (feet)	Bedrock Depth (feet)	Bedrock Elevation (feet)
P-1	99.13	30.0	69.13
P-10	102.26	31.5	70.76
P-17	99.89	31.5	68.39
W-17	98.96	33.0	65.96
		Average	68.56

Elevations are with reference to Hooker benchmark #2 at 101.08 feet.

TABLE 6. Depth of Sample Intervals Below Bedrock Surface

Well	Depth of Sample Interval Below Bedrock Surface (feet)
W-7	*26.55
W-12	*33.97
W-16	*33.89
W-17	20.00

*Estimate only (see text)

TABLE 7. Deep Well Status

Reconstructed	W-7, W-12, W-16
Drilled	W-17
Grouted	W-4, W-11
Open	W-2, W-13, W-9
?*	W-1, W-3, W-5, W-6, W-8, W-10, W-14, W-15

* Existence and location unknown (see text)

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TABLE 8. Well Descriptions (after La Sala, 1968)

Well	Year Completed	Depth (feet)	Diameter (inches)	Depth to Bedrock (feet)	Flow (gpd)	Comments
302-851-1	1938	*105	12	36	--	H_2S; cased to 42 ft; *pumping rate 1200 gpm; infrequently used because water quality is poor.
302-851-2	1947	*106	10	50	200,000	H_2S; *pumping rate 350 gpm
302-851-3	1948	*107	12	--	1,000,000	H_2S; *pumping rate 750 gpm

*Indicates data was reported, not confirmed by La Sala (1968)

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TABLE 9. Estimated Quantities of Waste Landfilled (after ITF, 1979)

Type of Waste	Physical State	Estimated Total Tonnage	Container
Phenol tar (containing chlorinated benzenes)	Liquid	250	Drums
Phenol bearing material (eg. phenolic resins and molding compounds)	Solid	28,000	Drums
Calcium aluminum oxide and calcium phosphate	Solid	250	Drums
	TOTAL	28,500	

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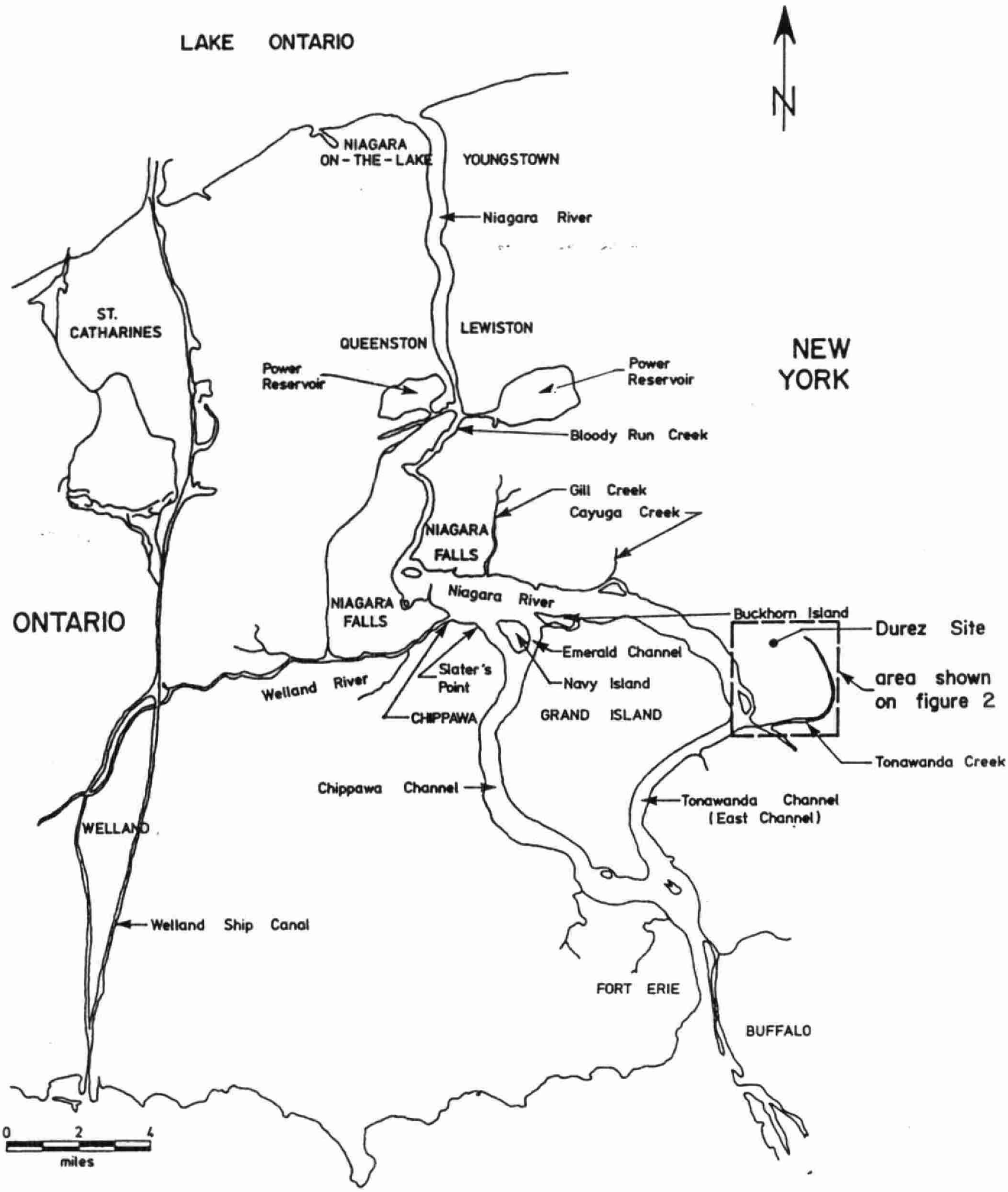

Figure 1: Plan of Niagara Region.

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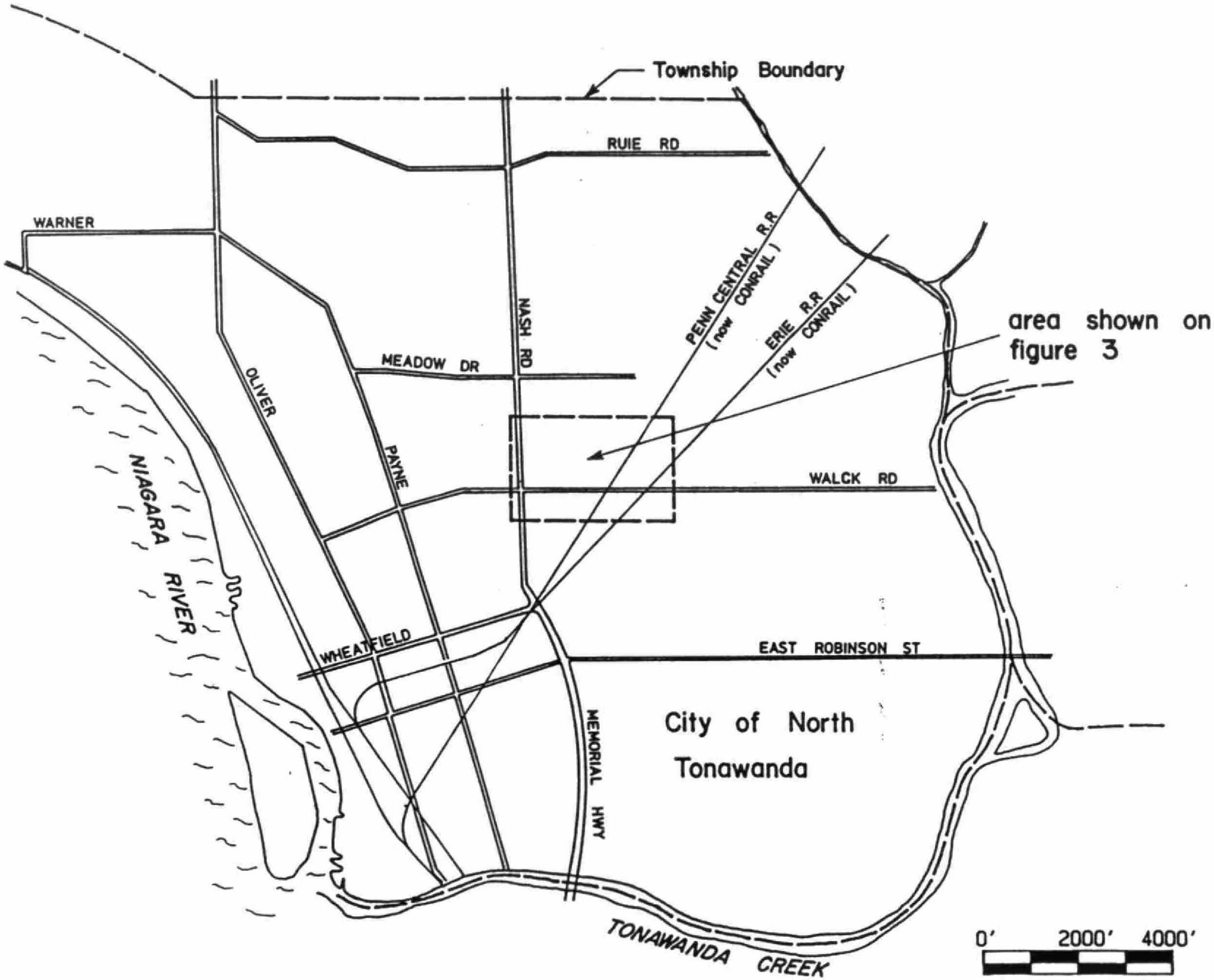

Figure 2: Plan of City of North Tonawanda.

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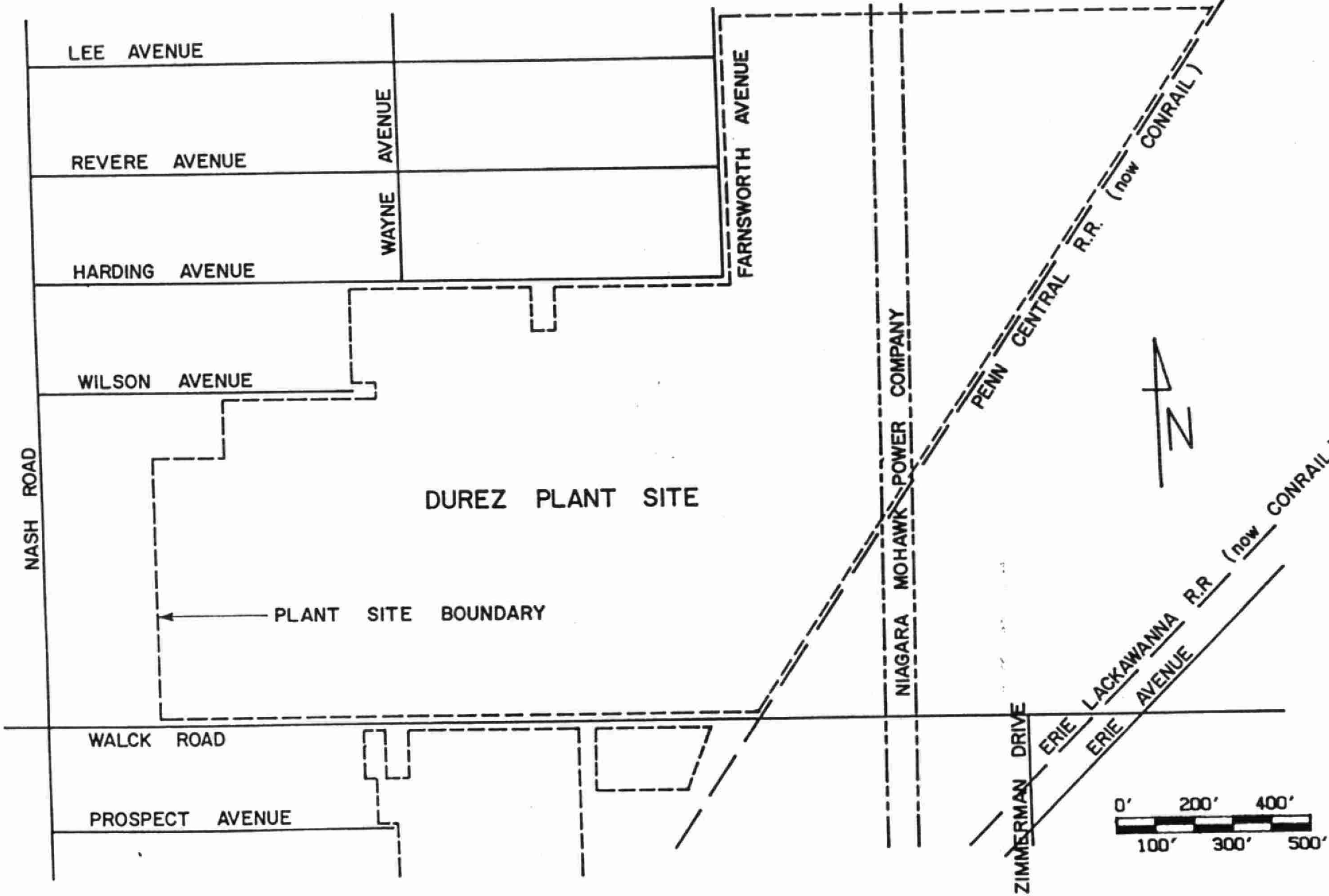

Figure 3: Plan of Durez Plant Site.

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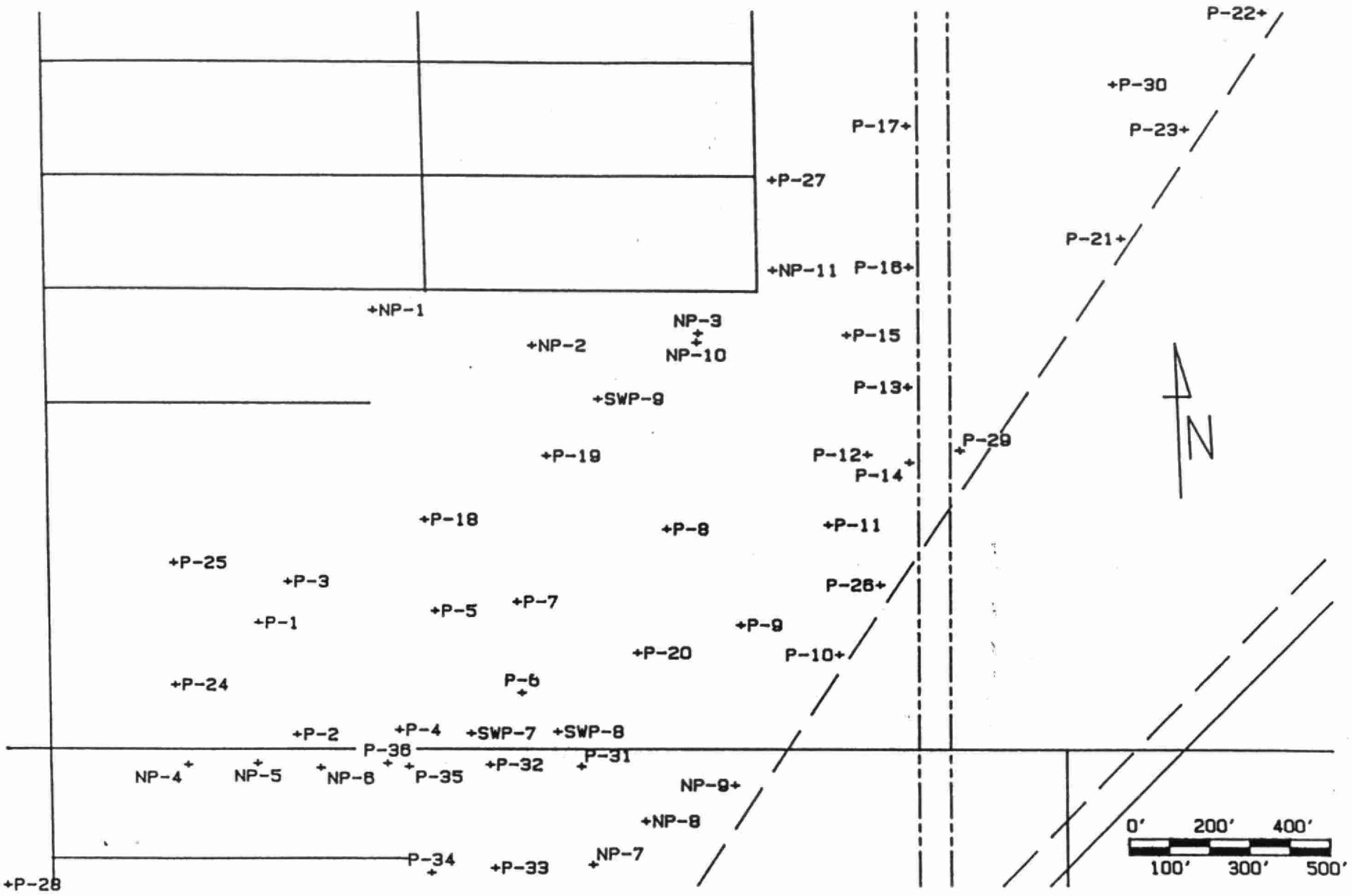

Figure 4: Location of shallow piezometers.

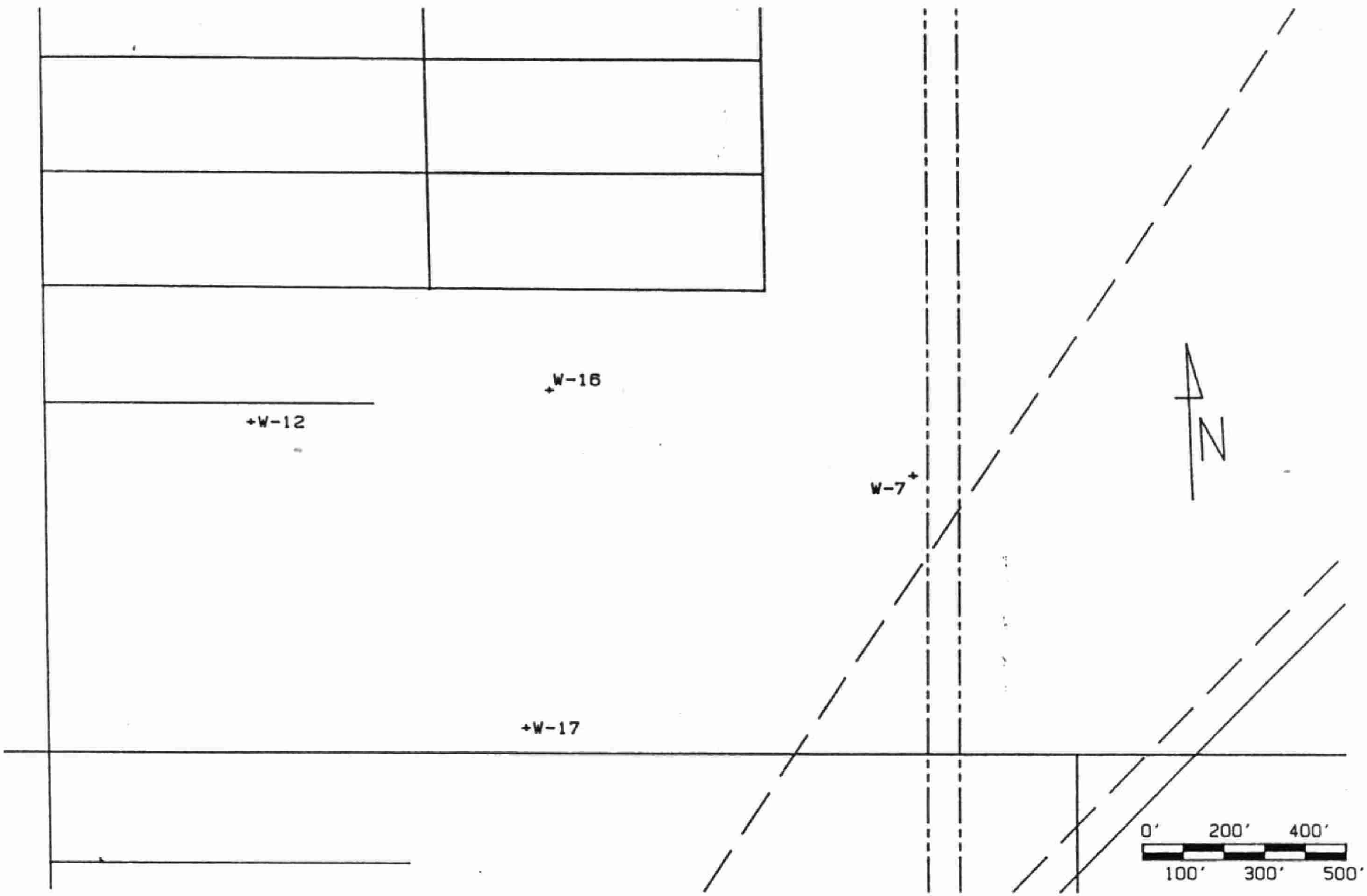

Figure 5: Location of deep wells.

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PERIOD	EPOCH	FORMATION	COLUMNAR SECTION	THICKNESS IN FEET	CHARACTER
QUATERNARY	RECENT	FILL		0-5	Gravel, flyash, coal dust, industrial waste, clean soil fill
		— DISCONFORMITY —			
	PLEISTOCENE (WISCONSIN AGE)	GLACIOLACUSTRINE SILT		2-7	Brown clayey silts to fine sand and silt
		— CONFORMABLE —			
		FLUVIAL SANDS AND GRAVEL		0-5	Medium to coarse sands occasionally grading to gravel
		— DISCONFORMITY —			
		GLACIOLACUSTRINE CLAY		16-23	Purple brown clay; very stiff at top becoming very soft at bottom; red, silty laminations increase with depth
		— CONFORMABLE —			
		TILL		0-7	Brown silty gravelly sand with cobbles
		— GREAT UNCONFORMITY —			
SILURIAN	UPPER SILURIAN	CAMILLUS SHALE FORMATION OF SALINA GROUP		180	Grey-green shale to carbonate mudstone, highly fractured, numerous veins and bodies of gypsum
	MIDDLE SILURIAN	LOCKPORT DOLOMITE		150	Dark grey to brown, massive to thin bedded dolomite

Figure 6: Representative geologic column (after Hooker, 1980).

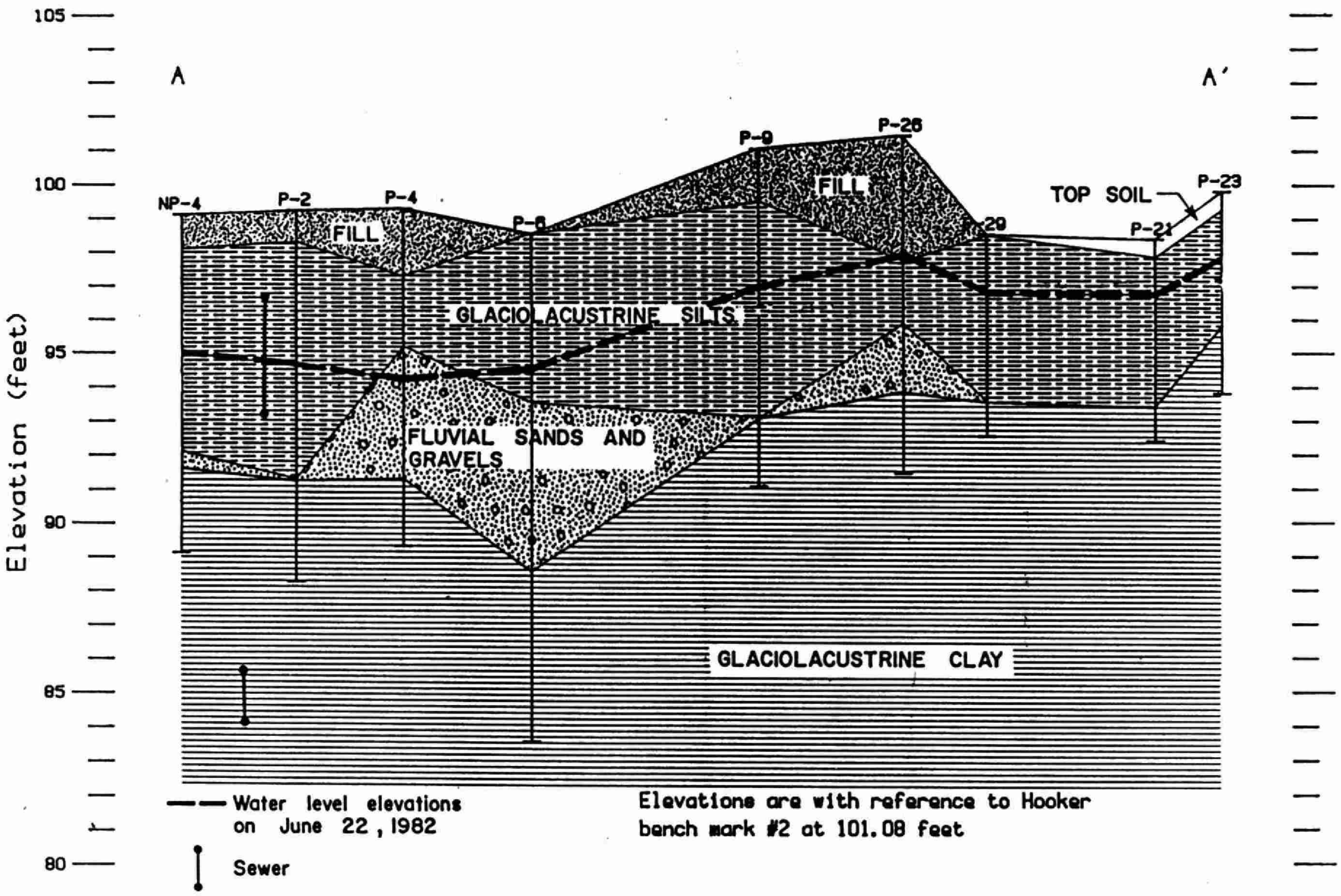

Figure 7: Overburden stratigraphic cross section A-A'.

GTC

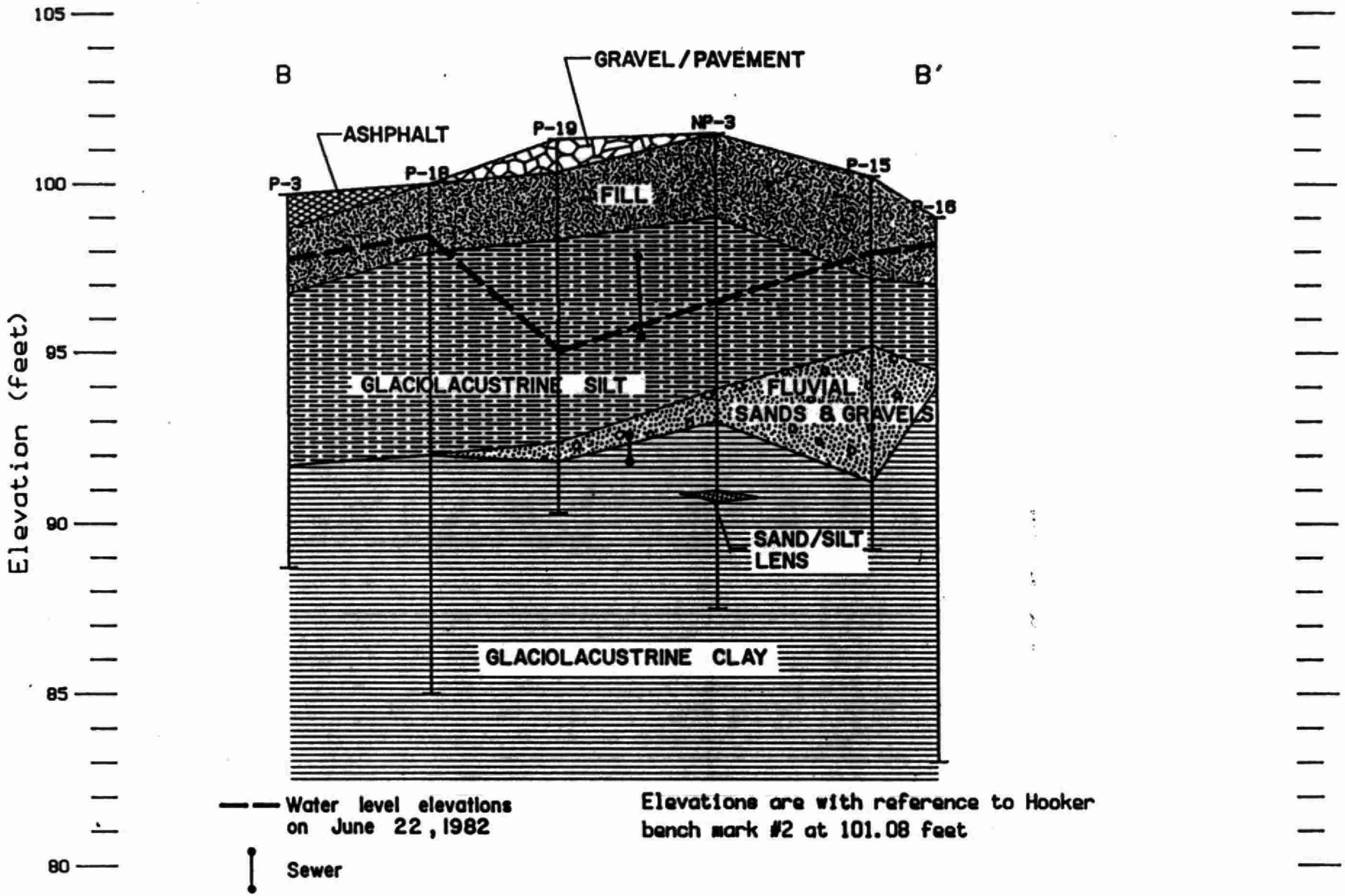

Figure 8: Overburden stratigraphic cross section B-B'.

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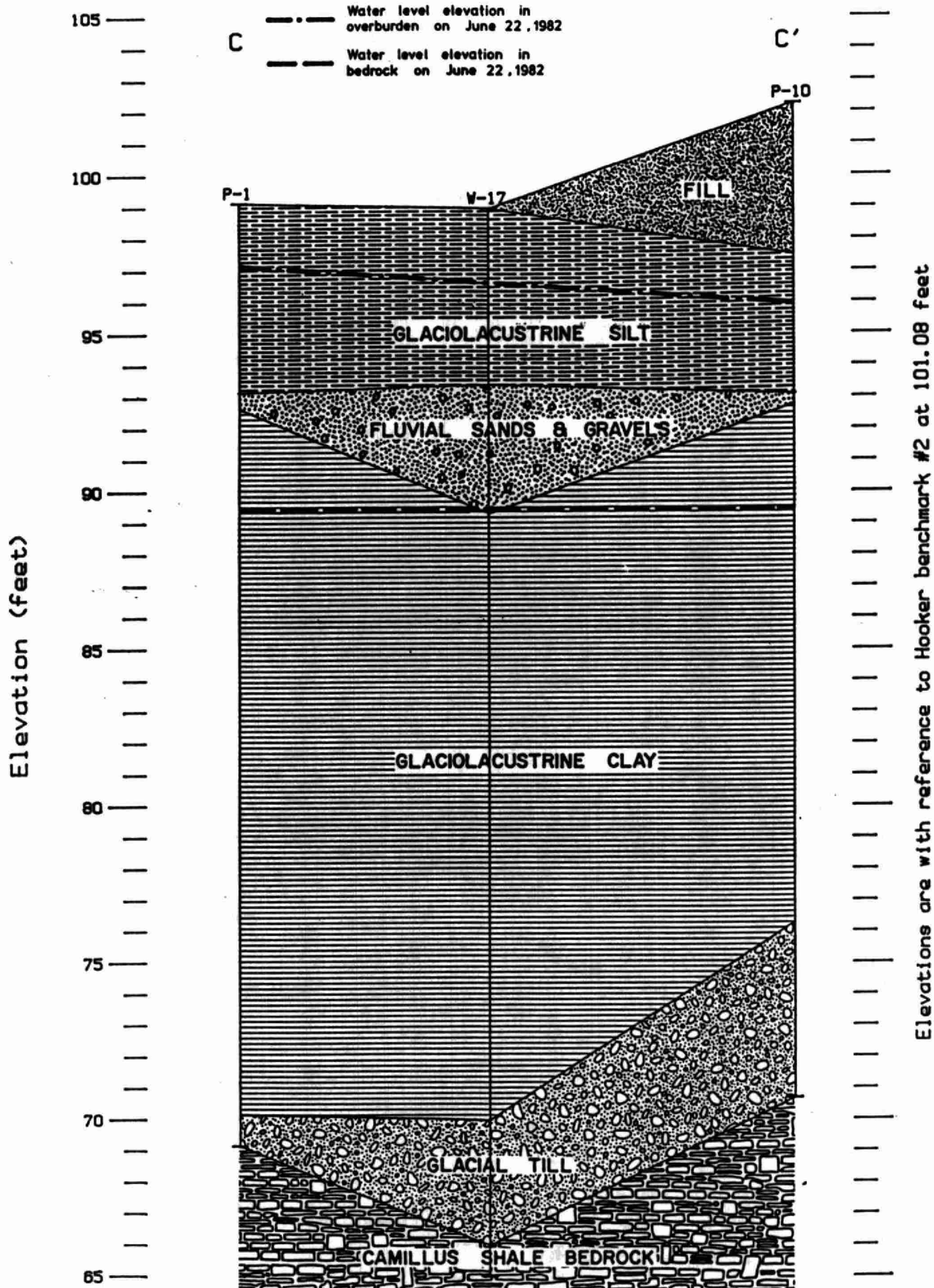

Figure 9: Stratigraphic cross section C-C'

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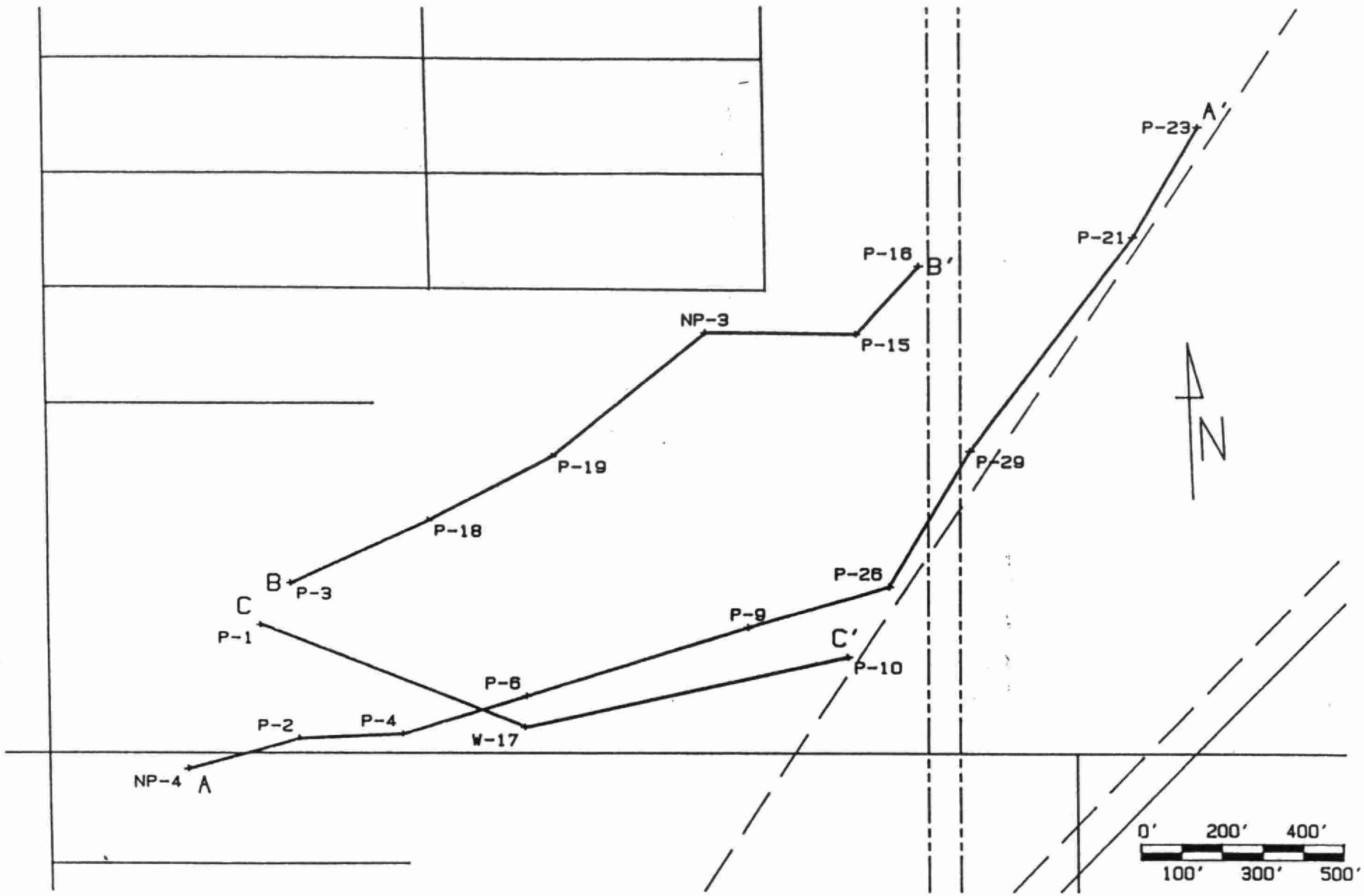

Figure 10: Location of stratigraphic cross sections.

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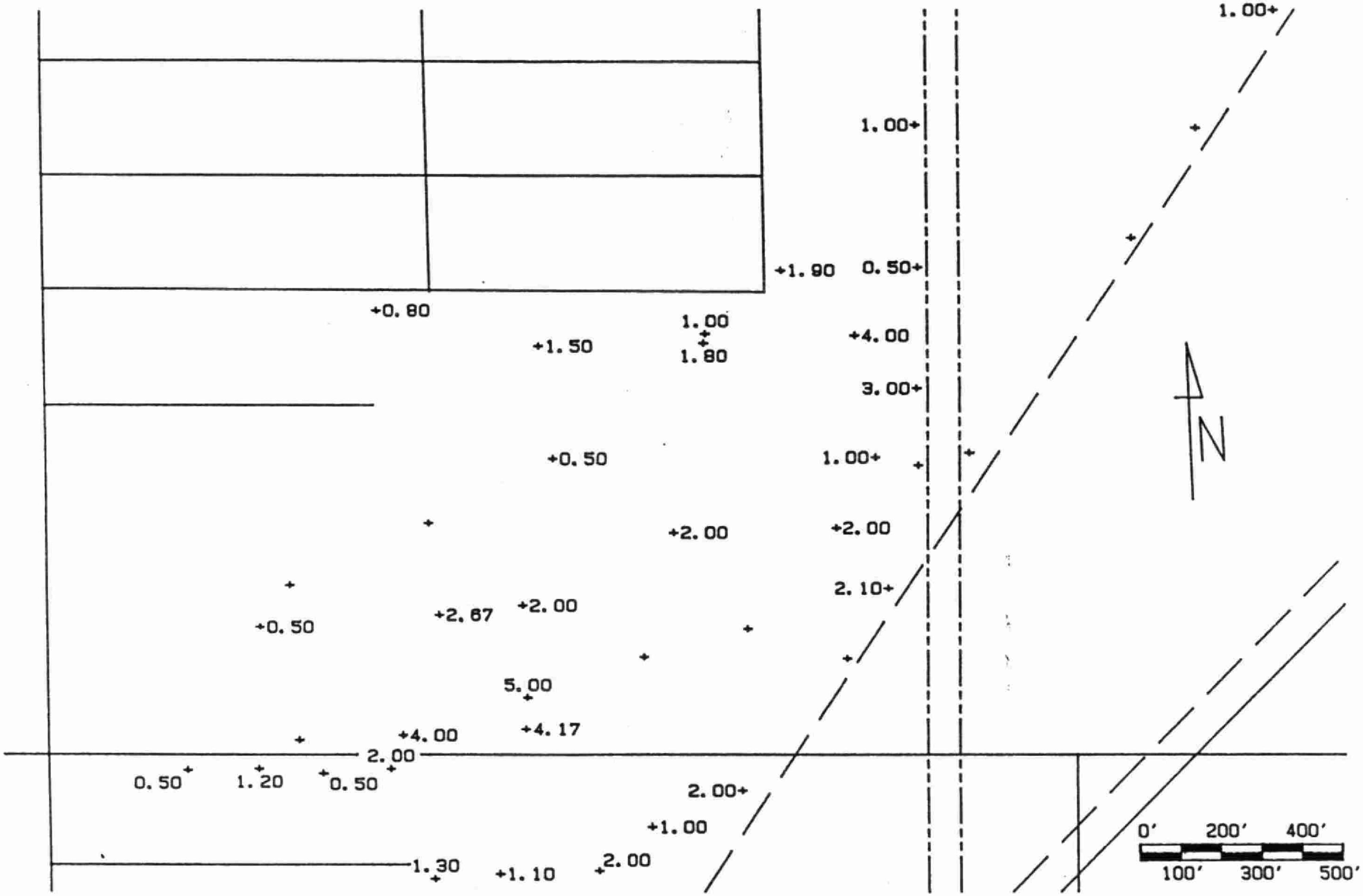

Figure 11: Thickness of fluvial sands and gravels in feet (+ only indicates that fluvial sands and gravels were not found at that location).

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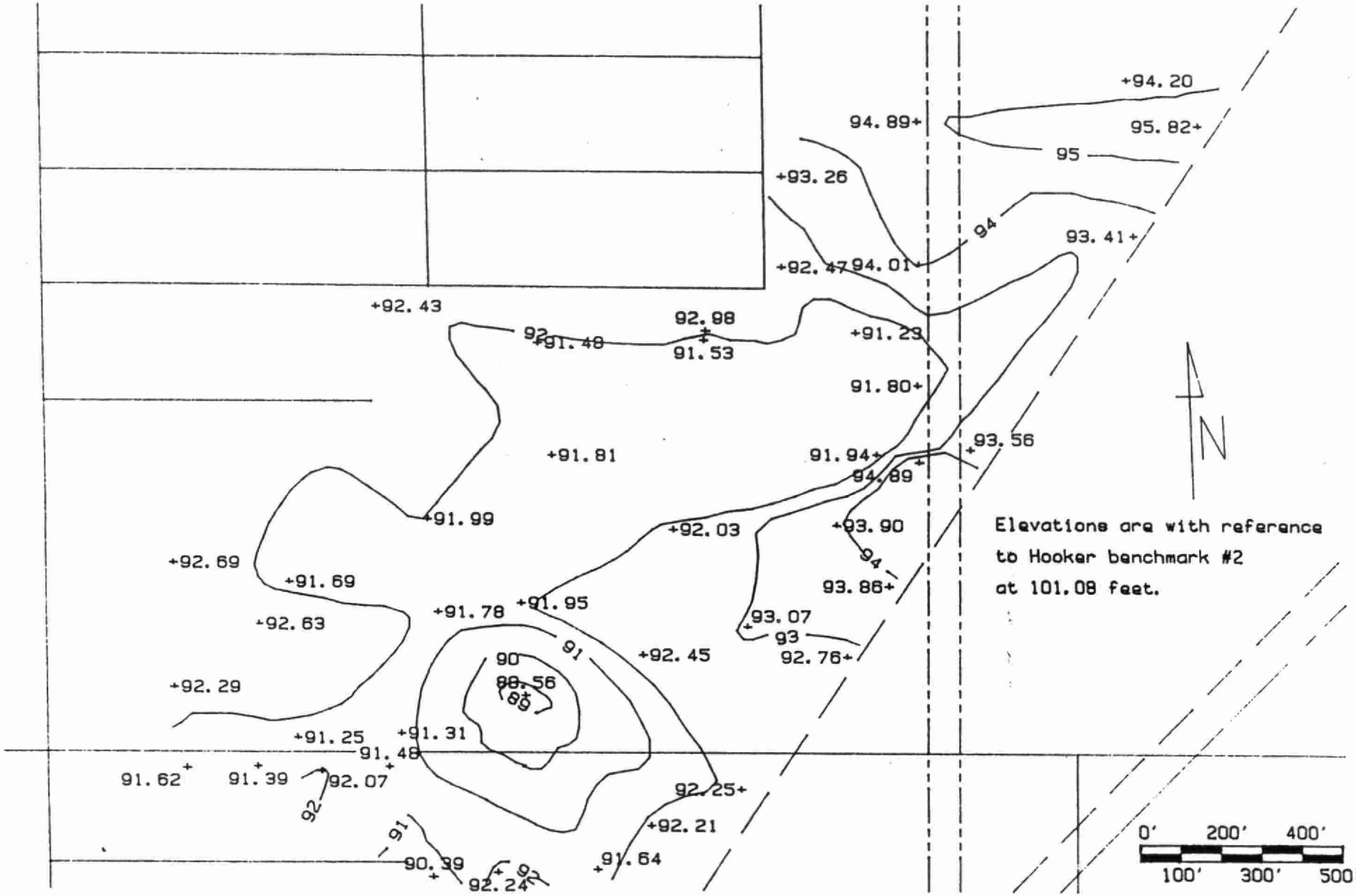

Figure 12: Contour diagram of the glaciolacustrine clay surface elevation.

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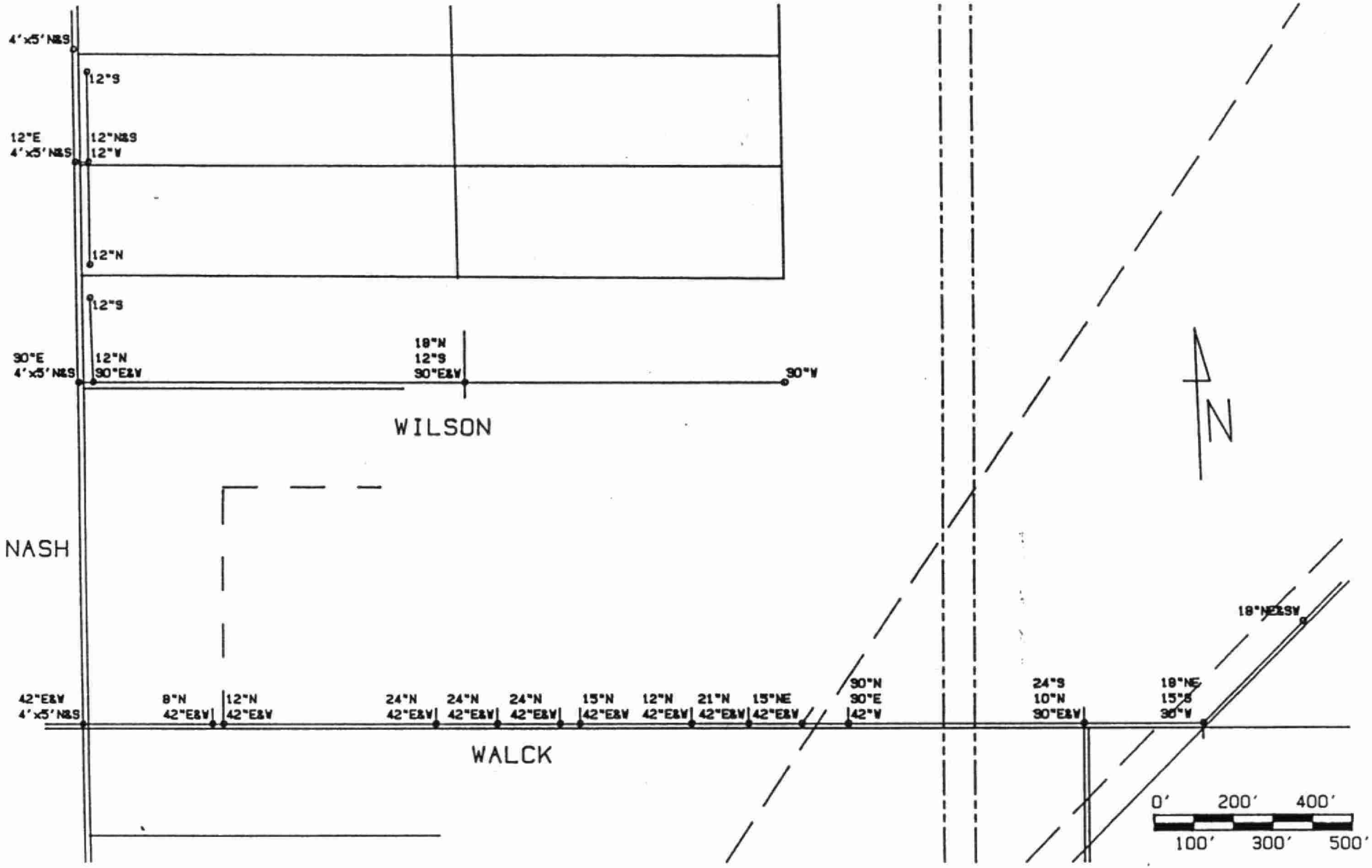

Figure 13: Schematic plan of storm sewer system components.

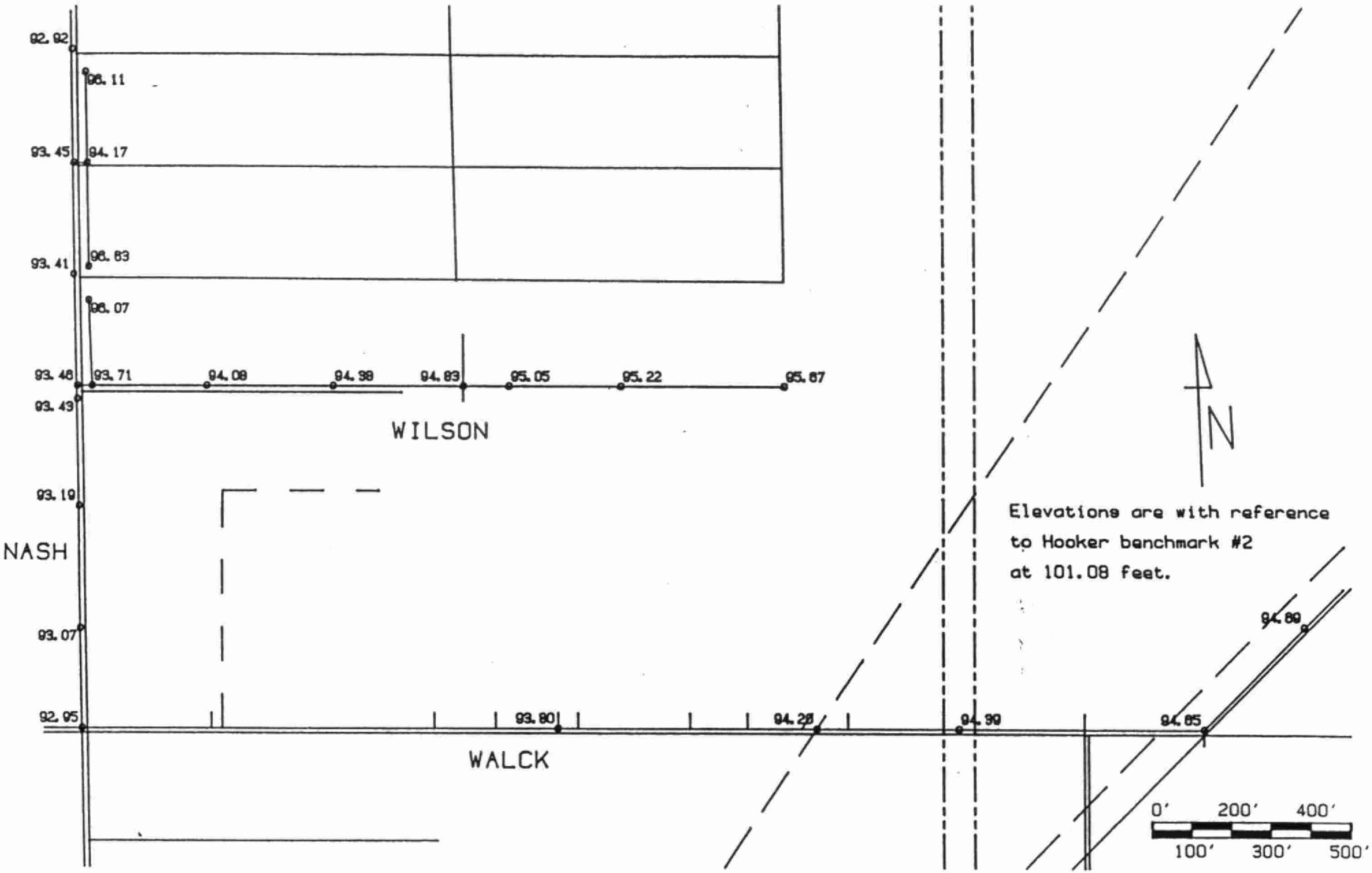

Figure 14: Invert elevations of storm sewer system components.

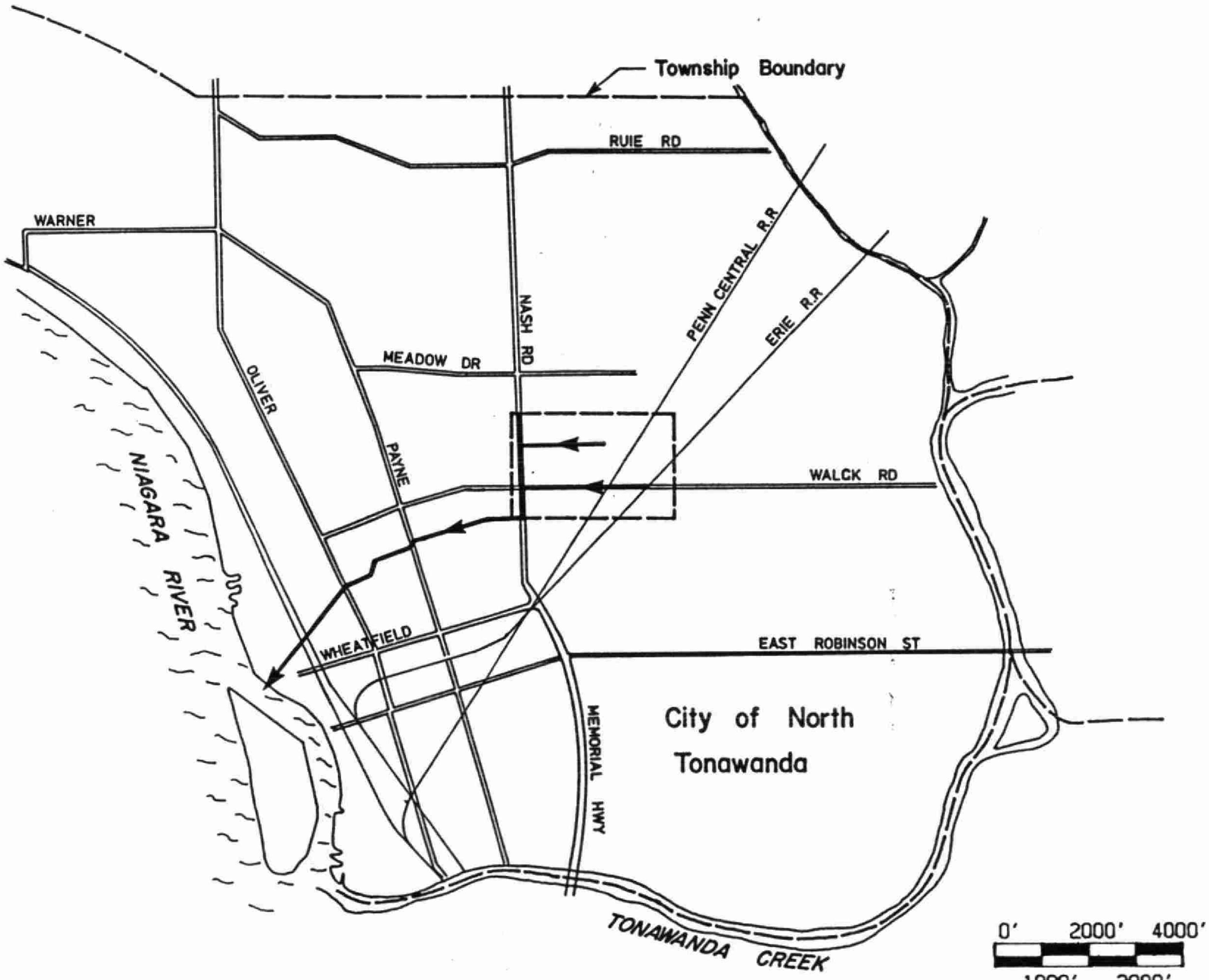

Figure 15: Storm sewer flow directions and route to final discharge.

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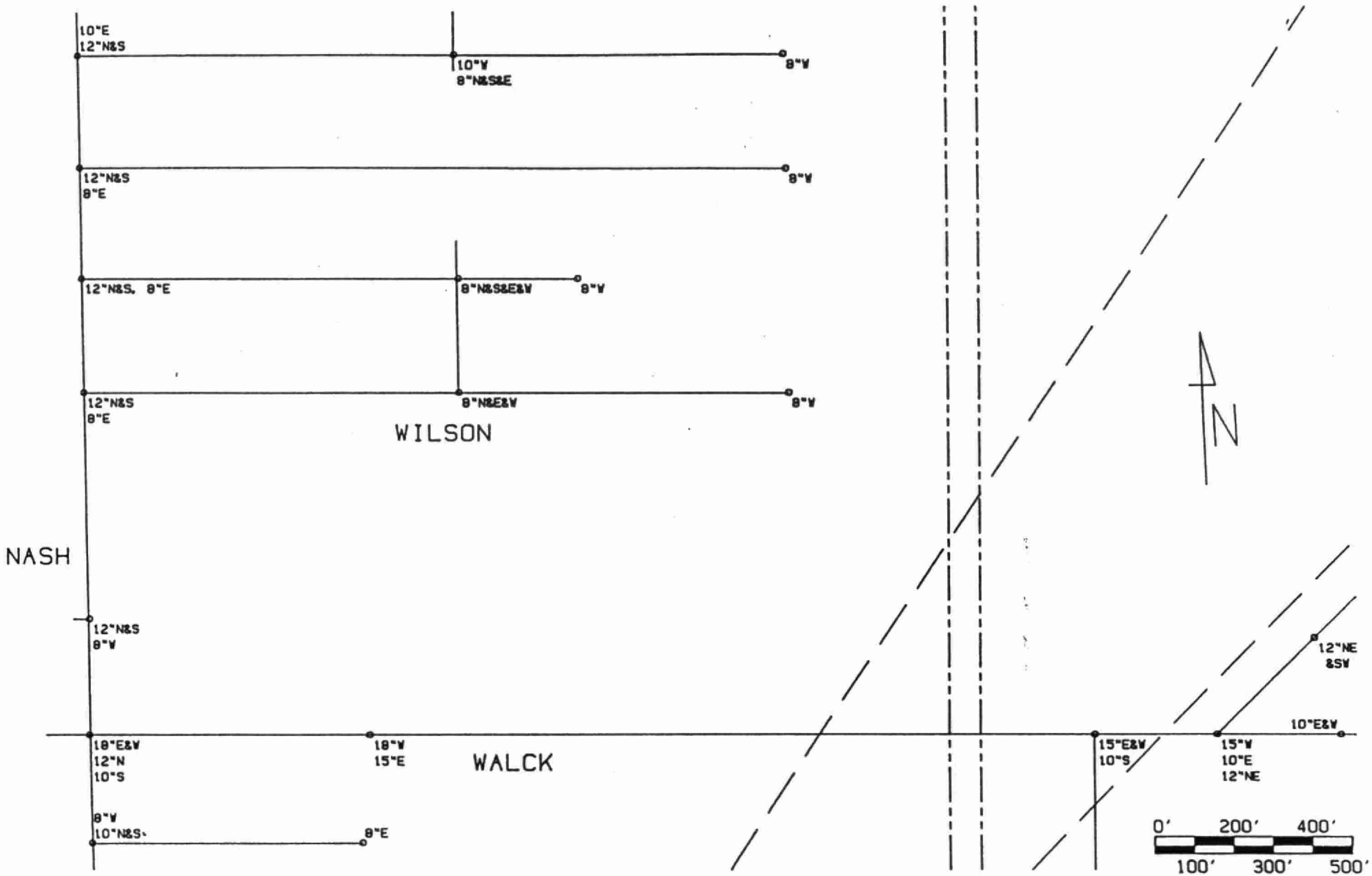

Figure 16: Schematic plan of sanitary sewer system components.

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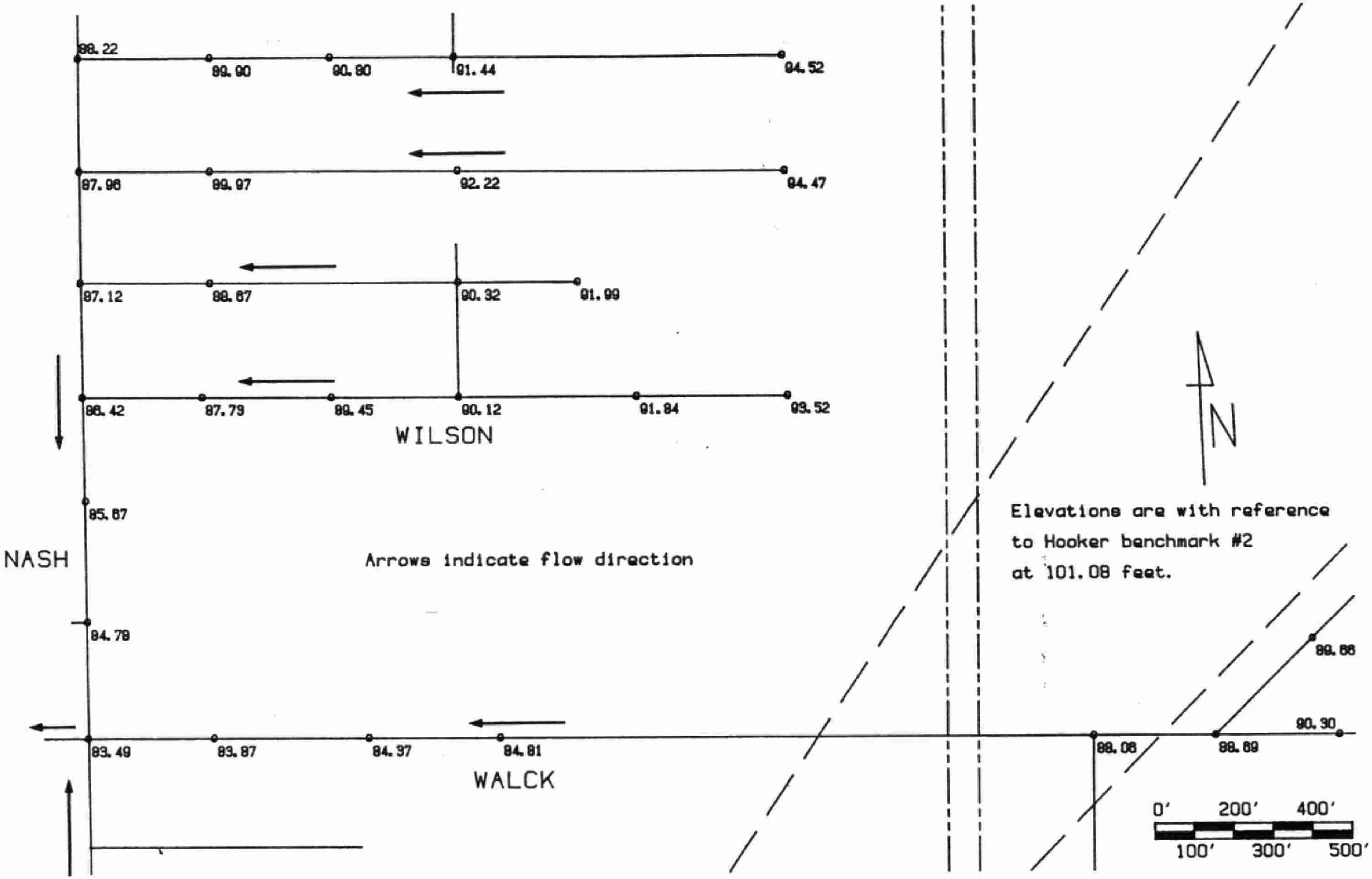

Figure 17: Invert elevations of sanitary sewer system components.

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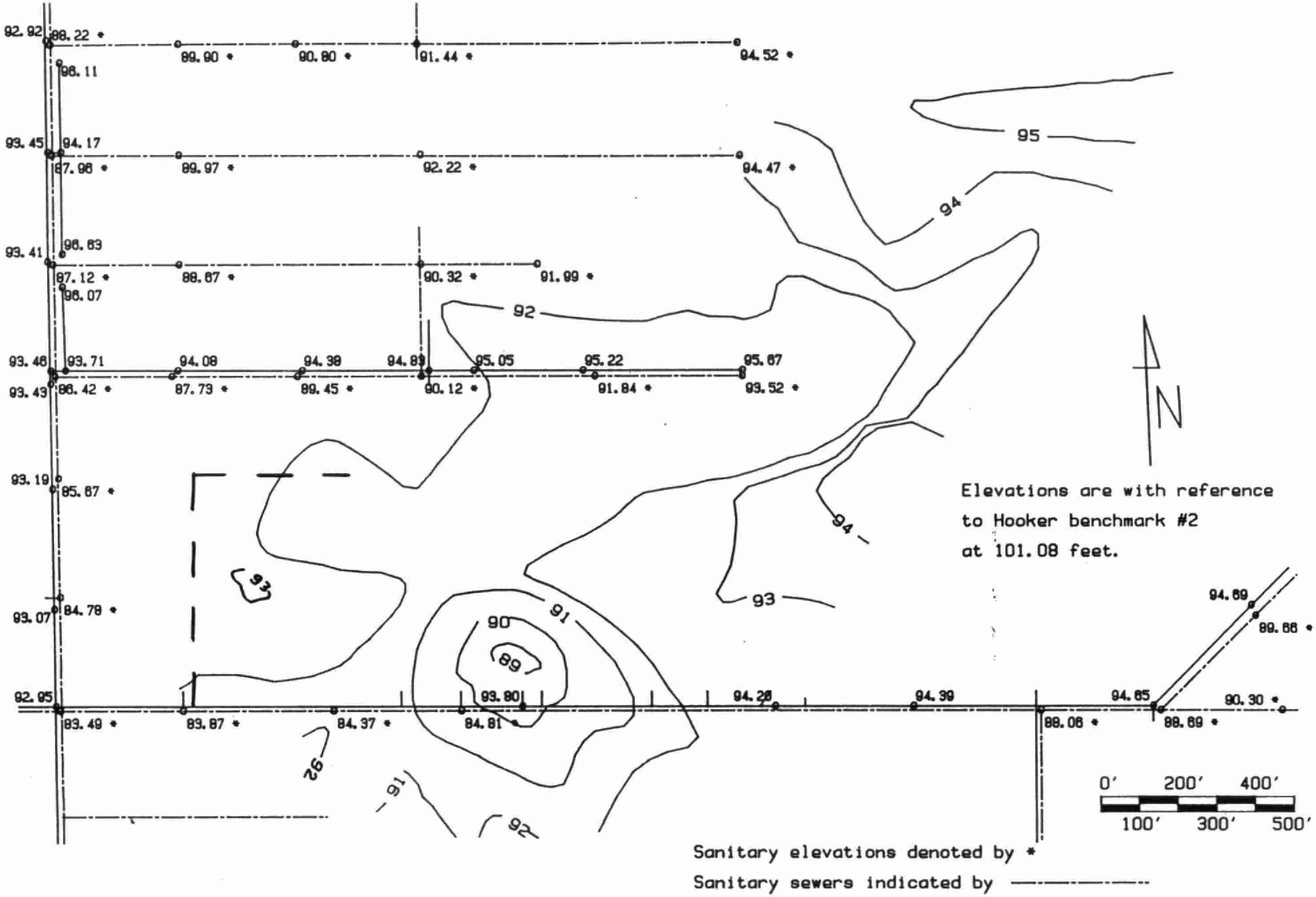

Figure 18: Storm and sanitary sewer system invert elevations and elevation contours for surface of glaciolacustrine clay.

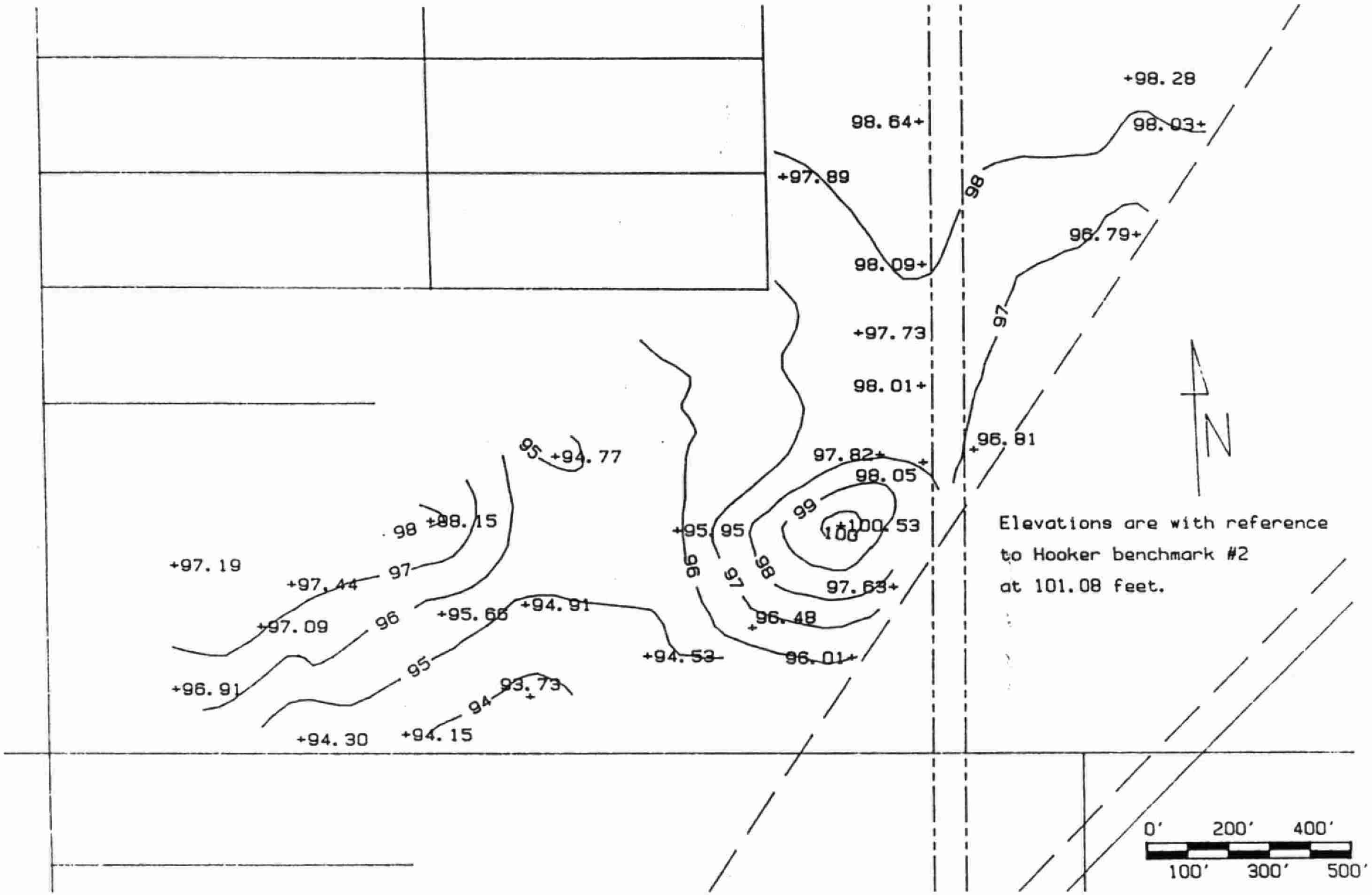

Figure 19: Water level elevation contours for January 10, 1980.

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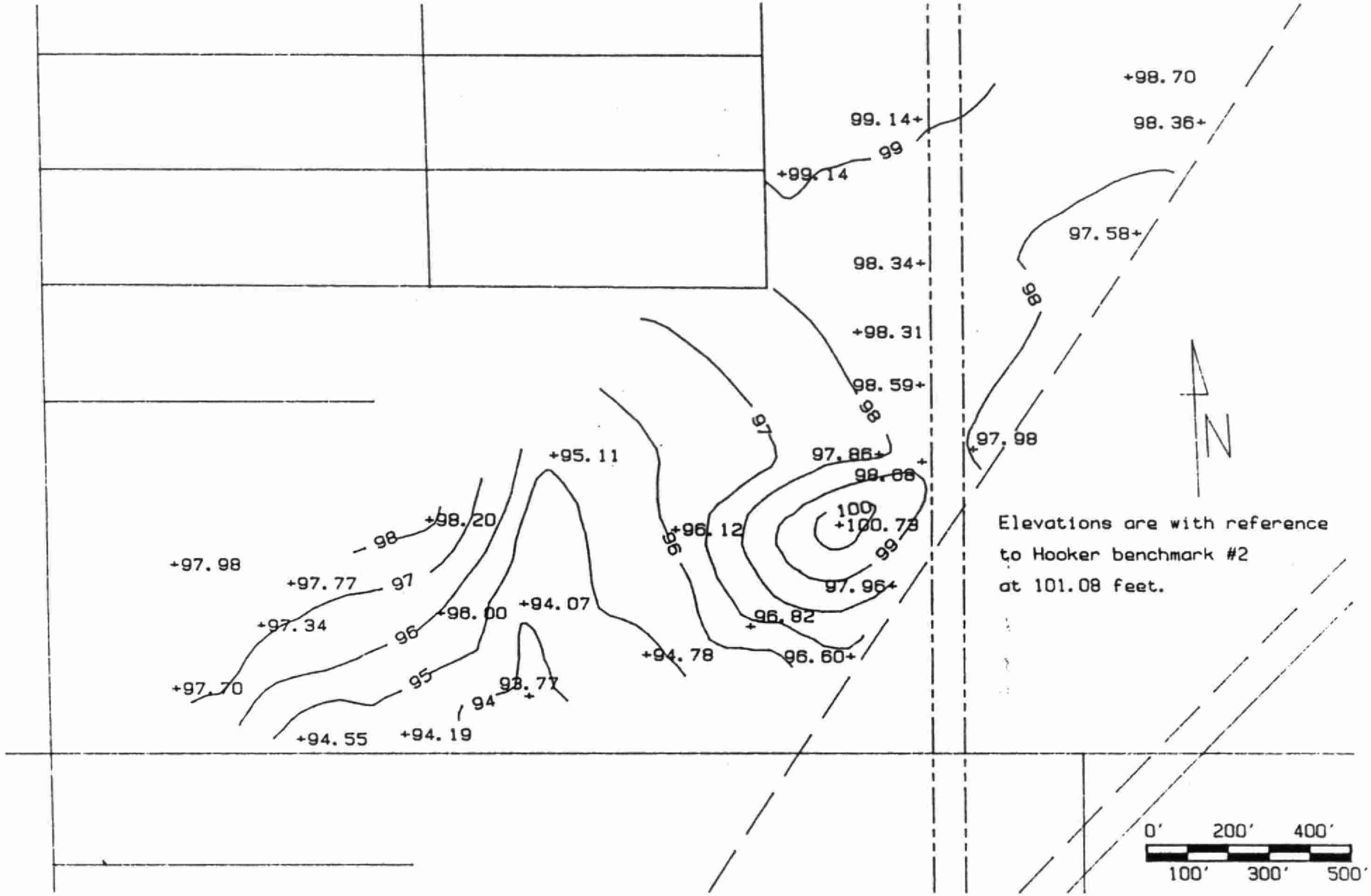

Elevations are with reference
to Hooker benchmark #2
at 101.08 feet.

Figure 20: Water level elevation contours for January 15, 1980.

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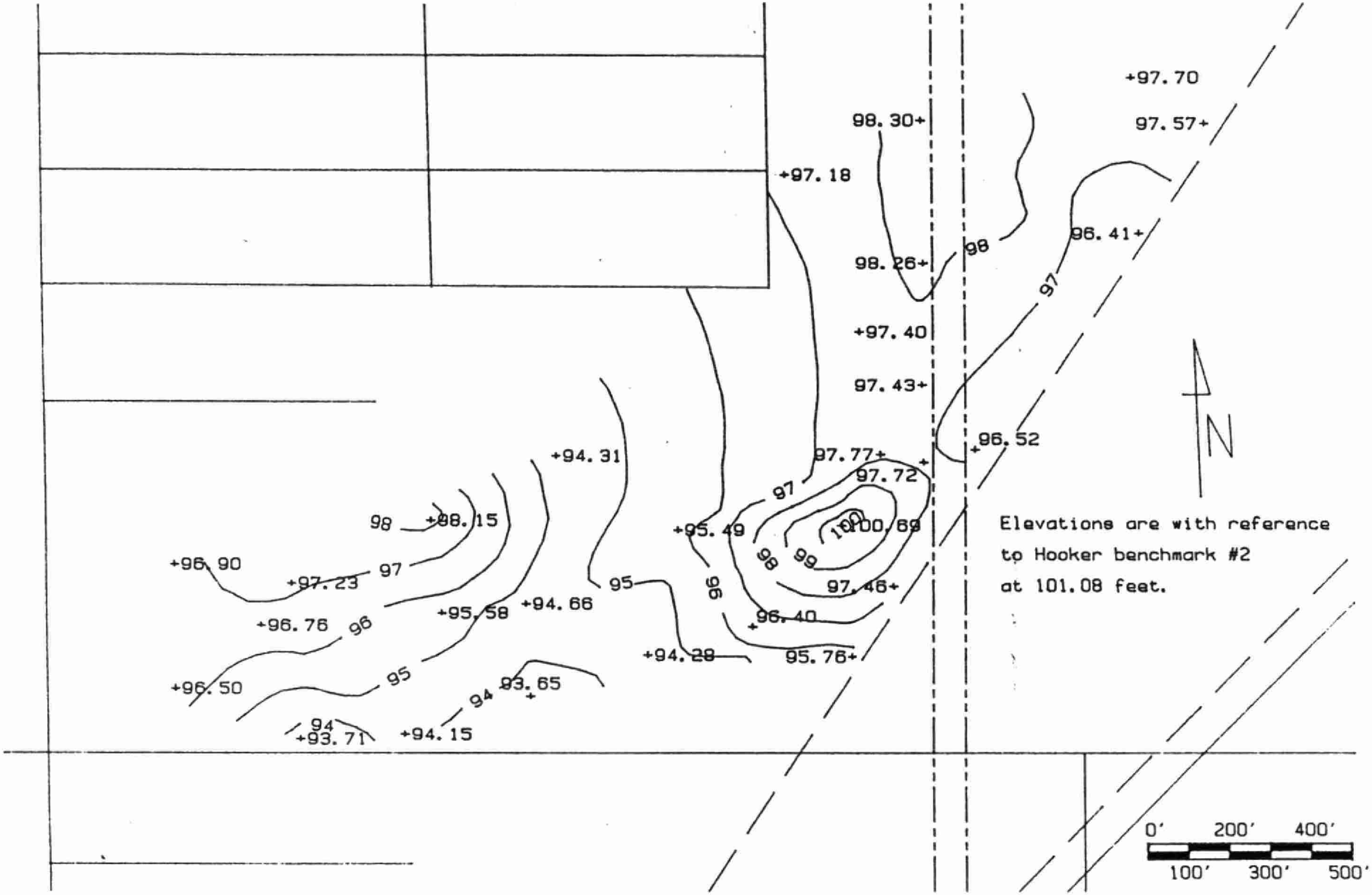

Figure 21: Water level elevation contours for February 5, 1980.

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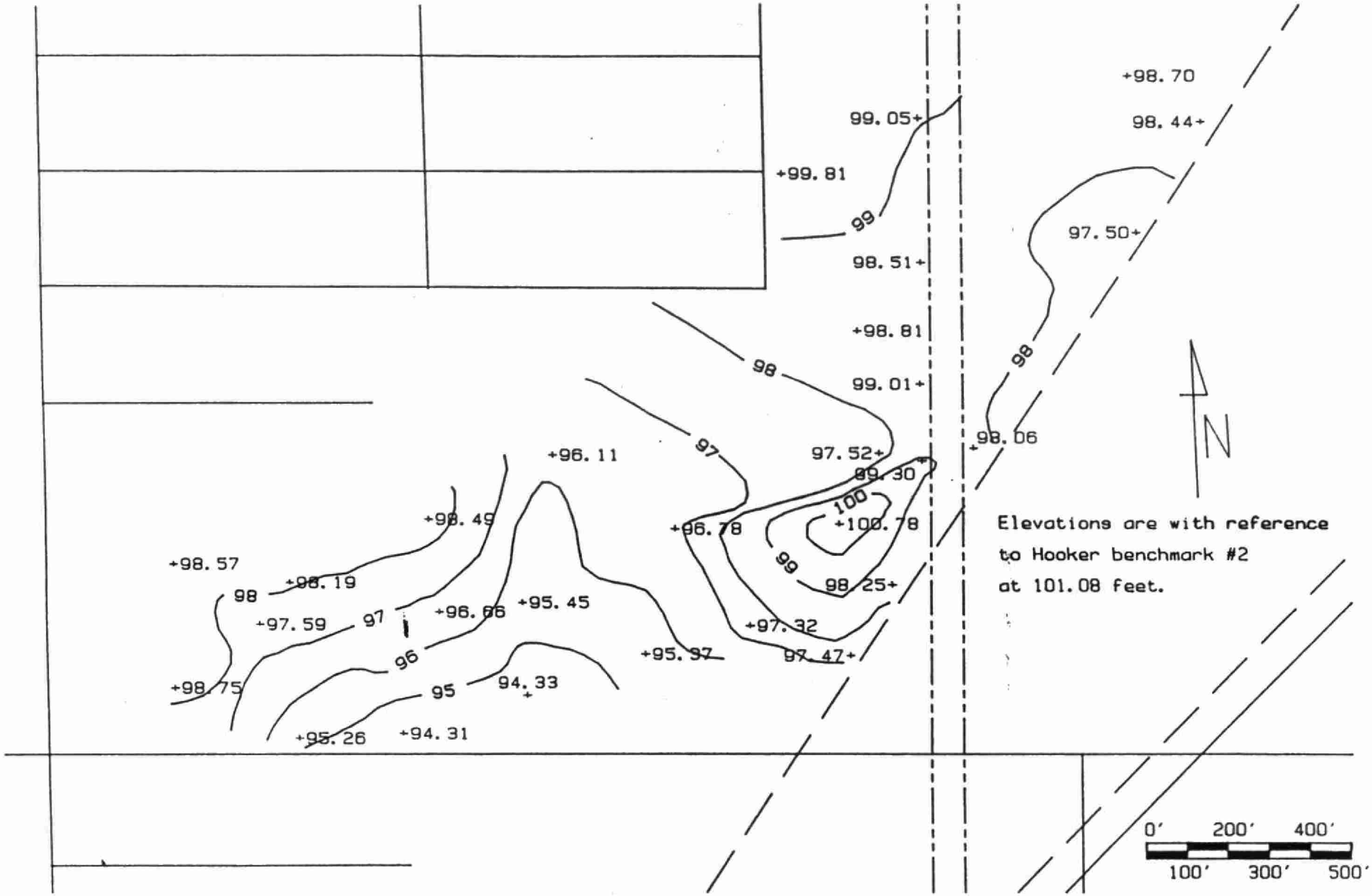

Figure 22: Water level elevation contours for April 1 to 3, 1980.

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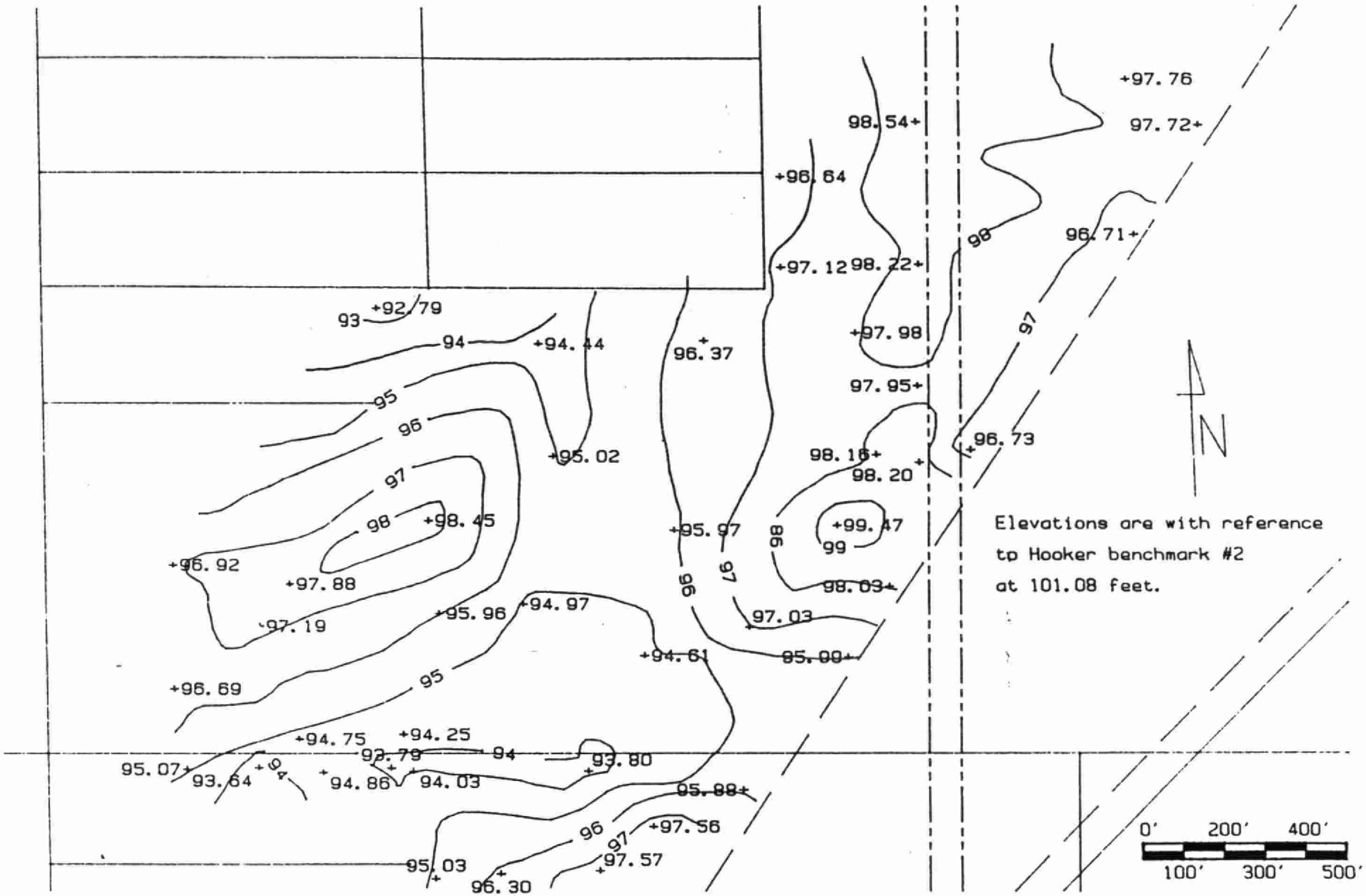

Figure 23: Water level elevation contours for June 22, 1982.

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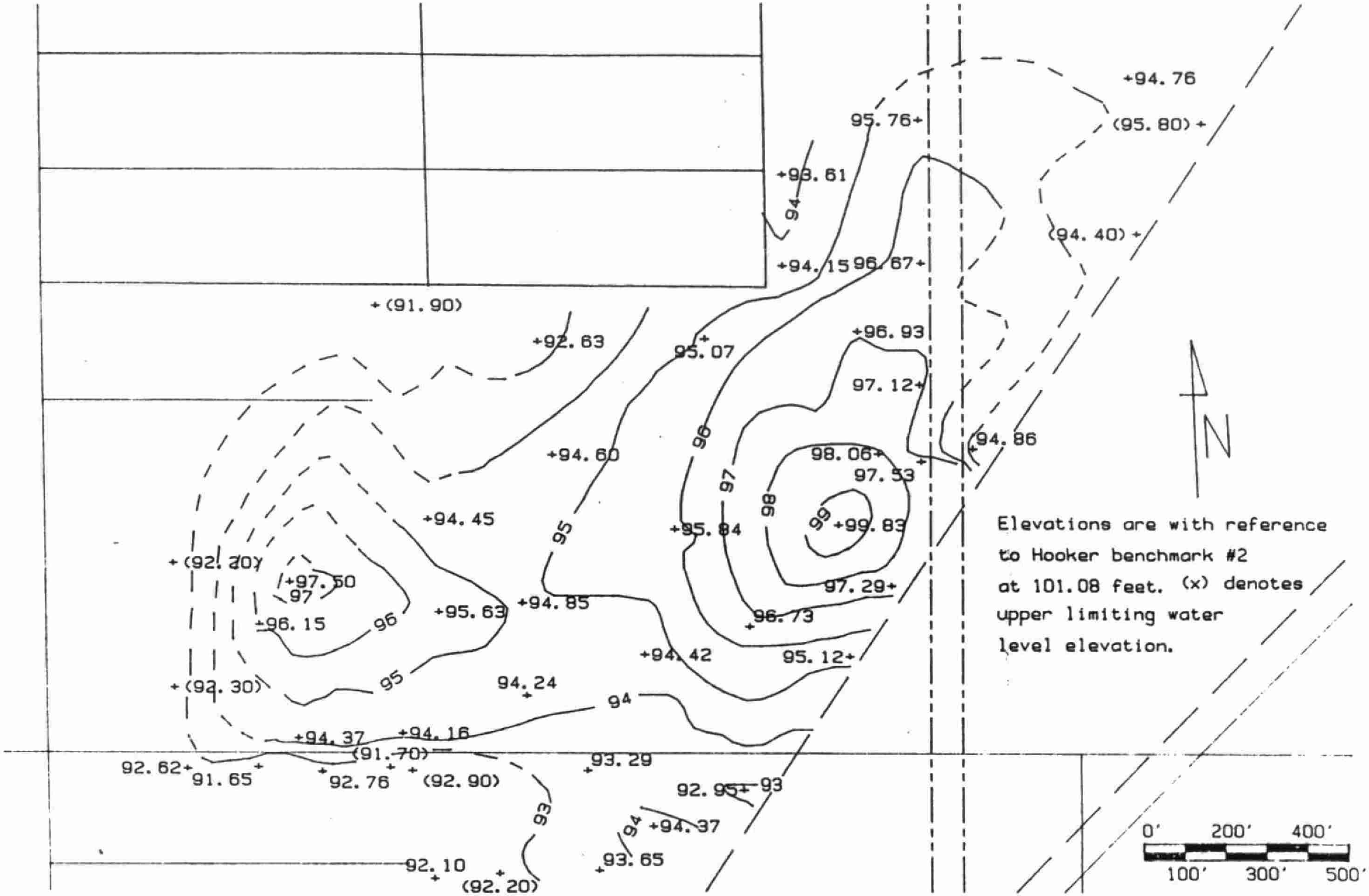

Figure 24: Water level elevation contours for August 17, 1982.
(dashed lines indicate existence of contour and not precise contour location)

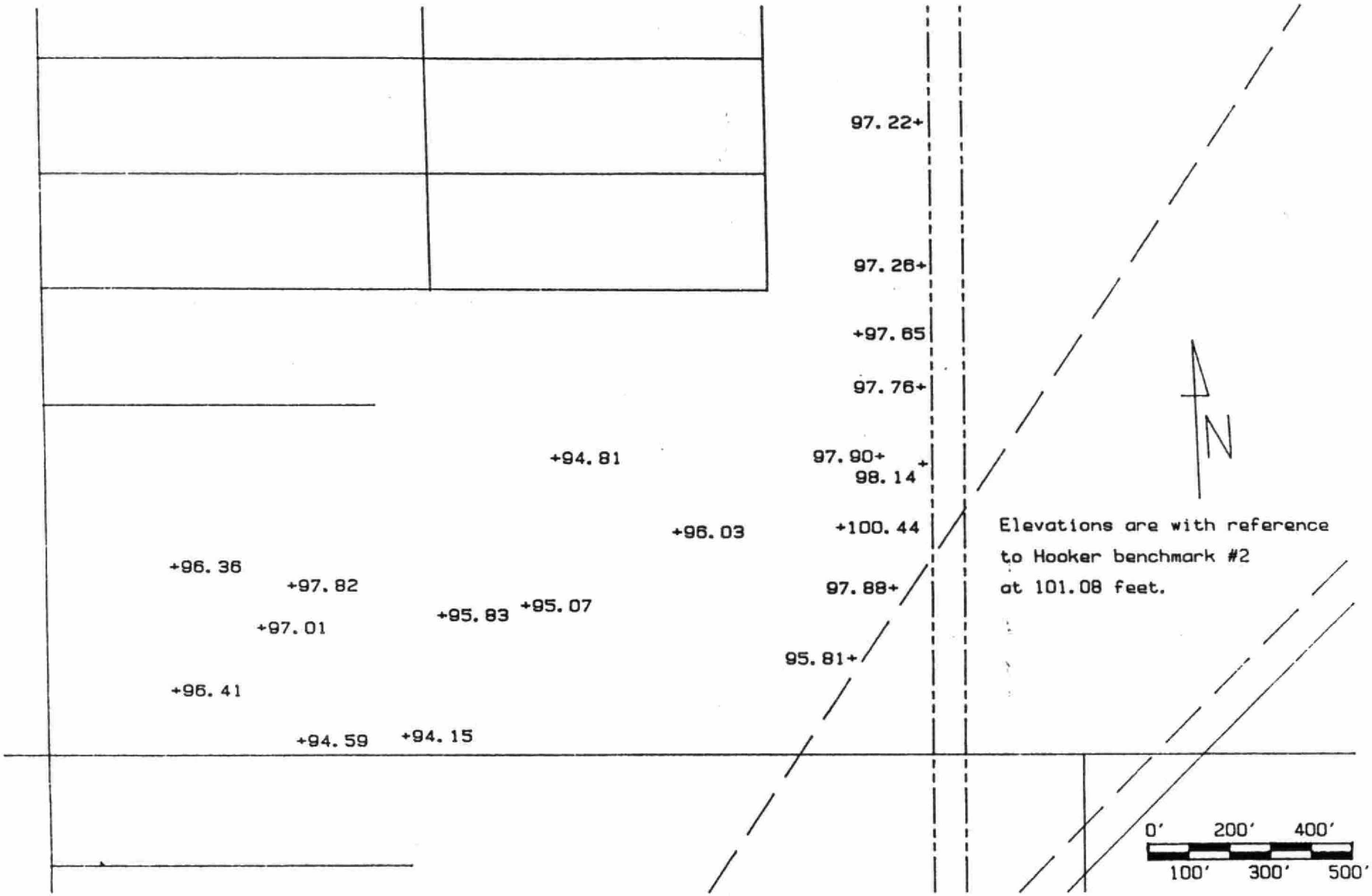

Figure 25: Water level elevations at piezometer locations for June 17 and 18, 1980. (Not contoured due to insufficient data).

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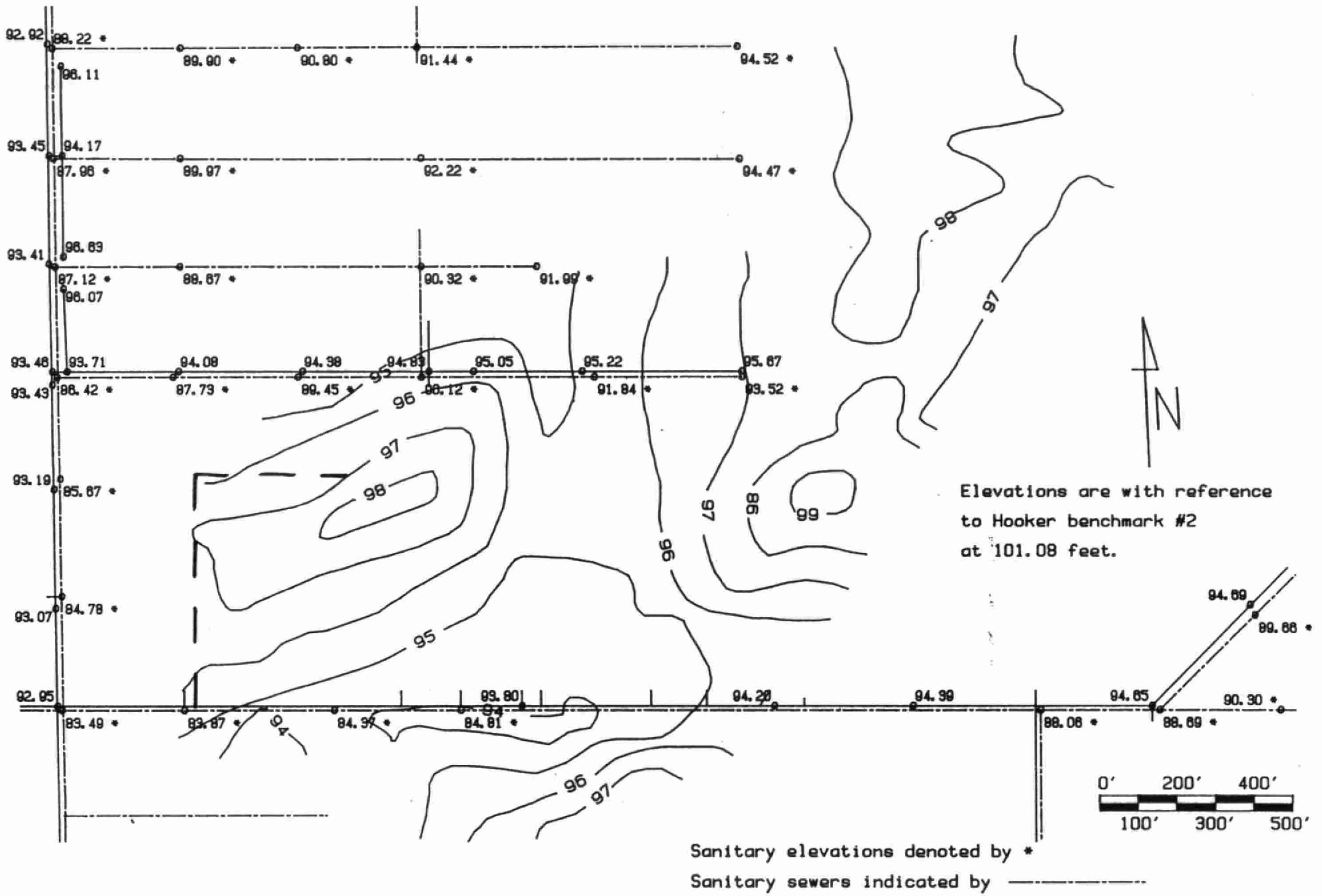

Figure 26: Storm and sanitary sewer system invert elevations and water level elevation contours for June 6, 1982.

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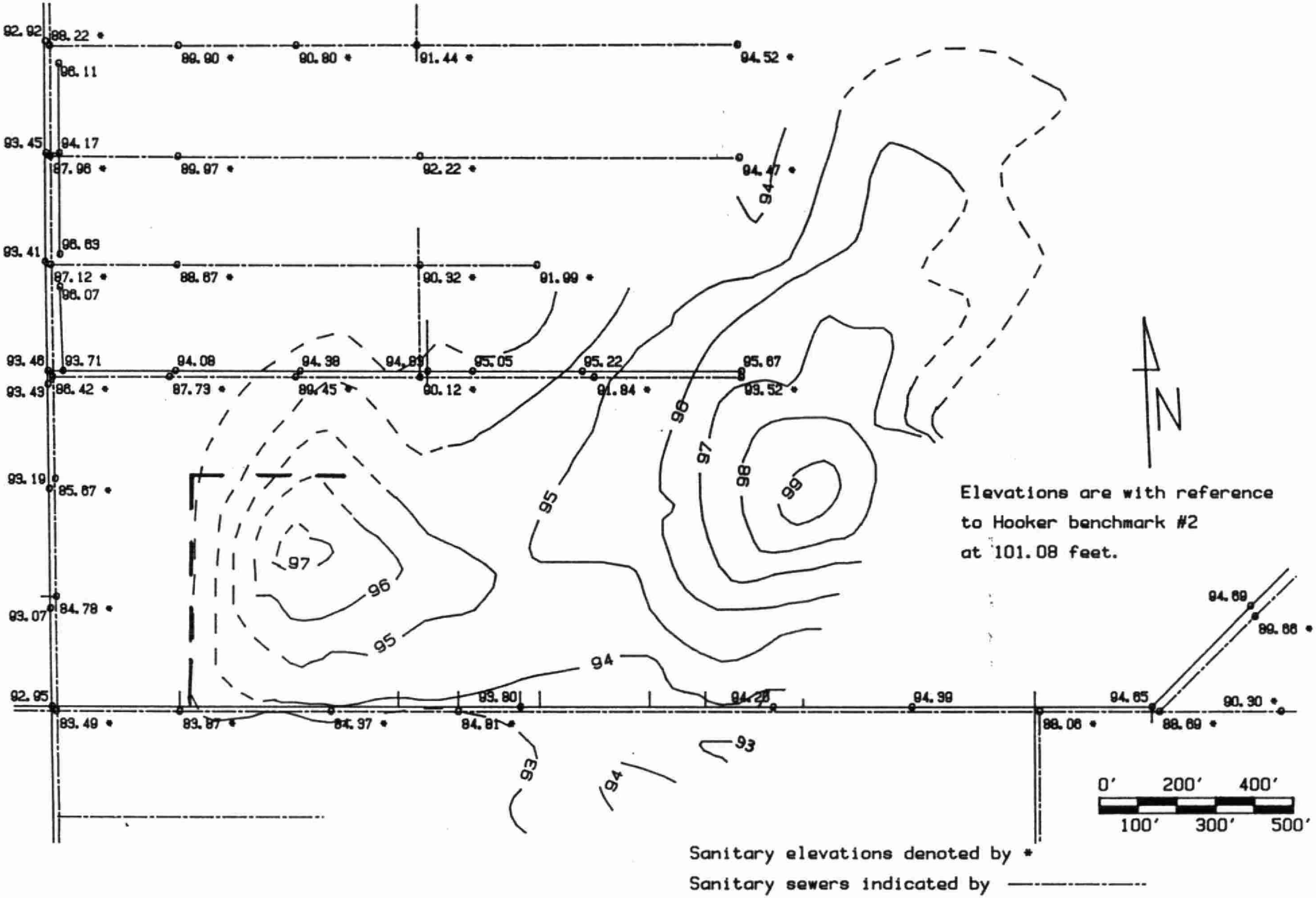

Figure 27: Storm and sanitary sewer system invert elevations and water level elevation contours for August 17, 1982.

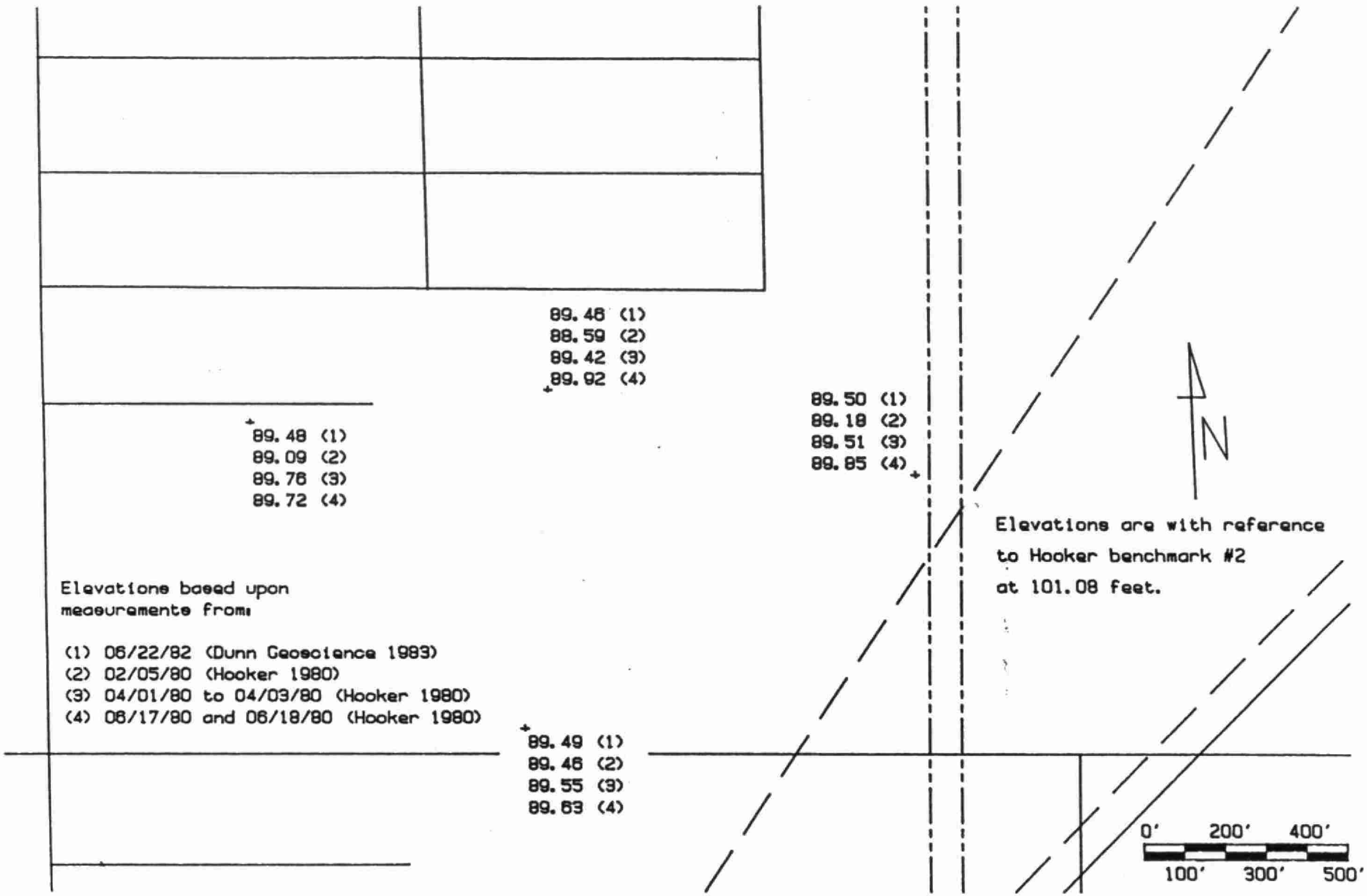

Figure 28: Piezometric elevations for the bedrock aquifer.

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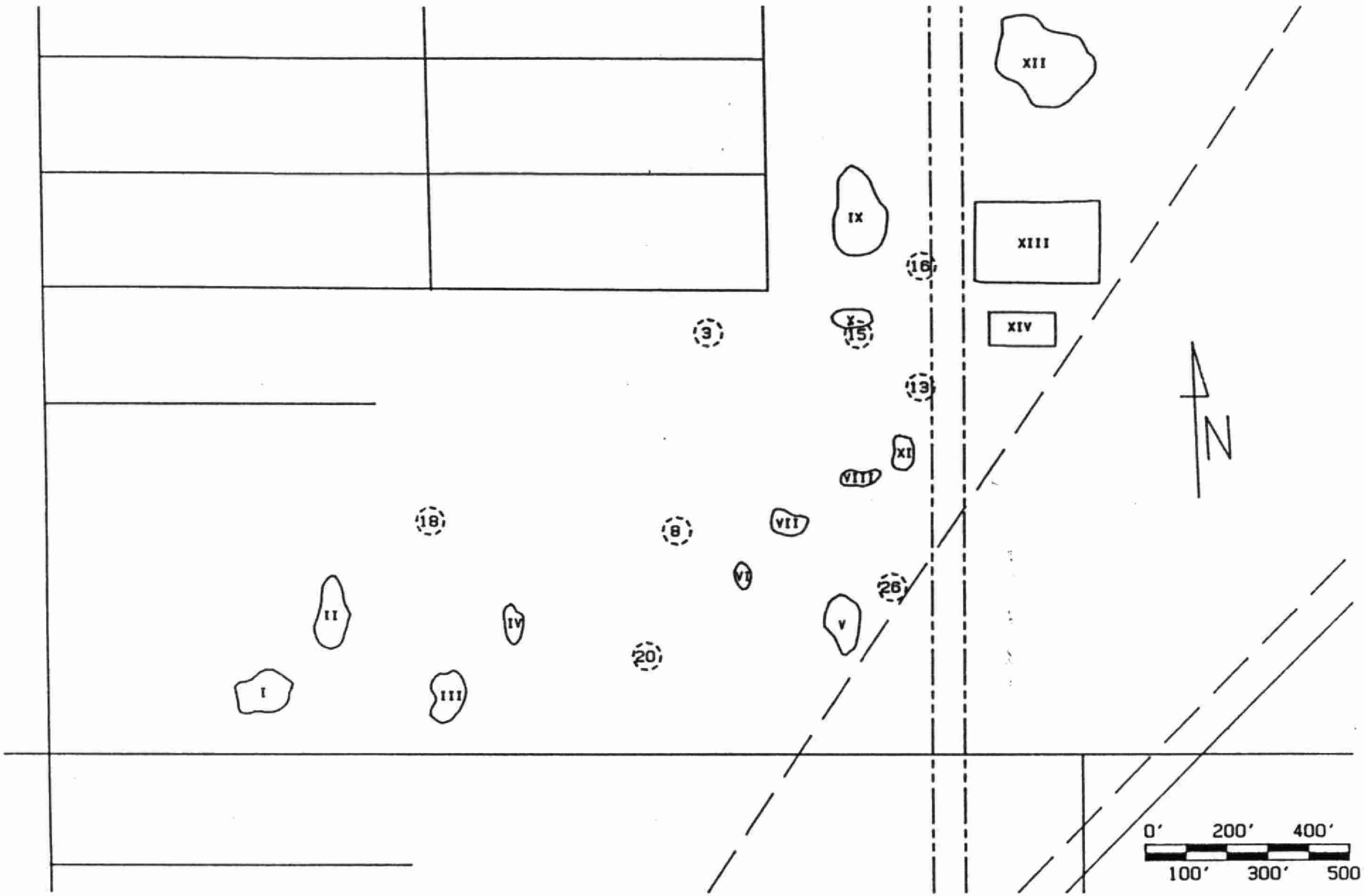

Figure 29: Locations of documented and possible waste disposal sites. (solid lines indicate areal extent, dashed lines indicate location only)

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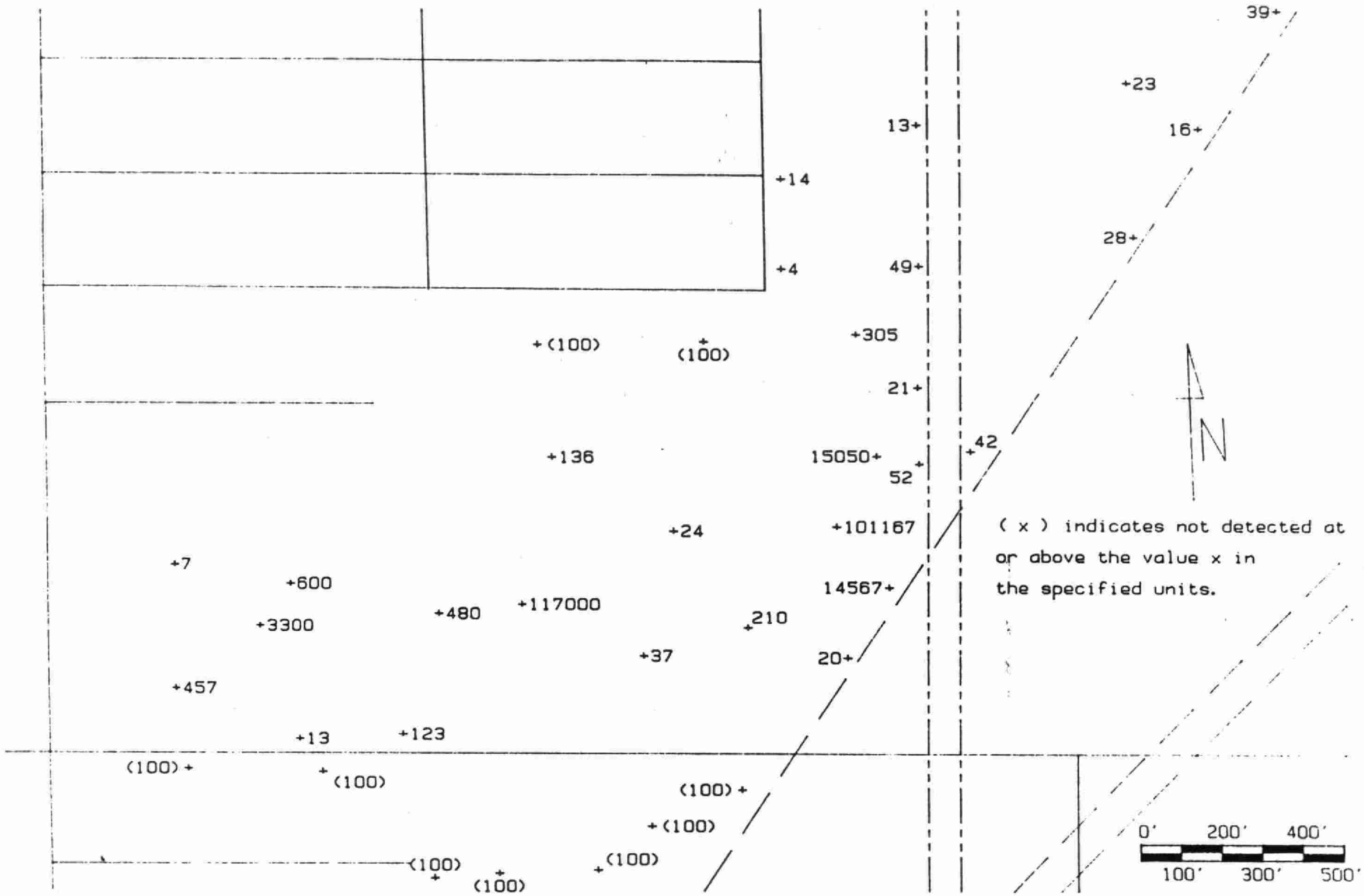

Figure 30: Average concentration of phenols in ug/L at piezometers from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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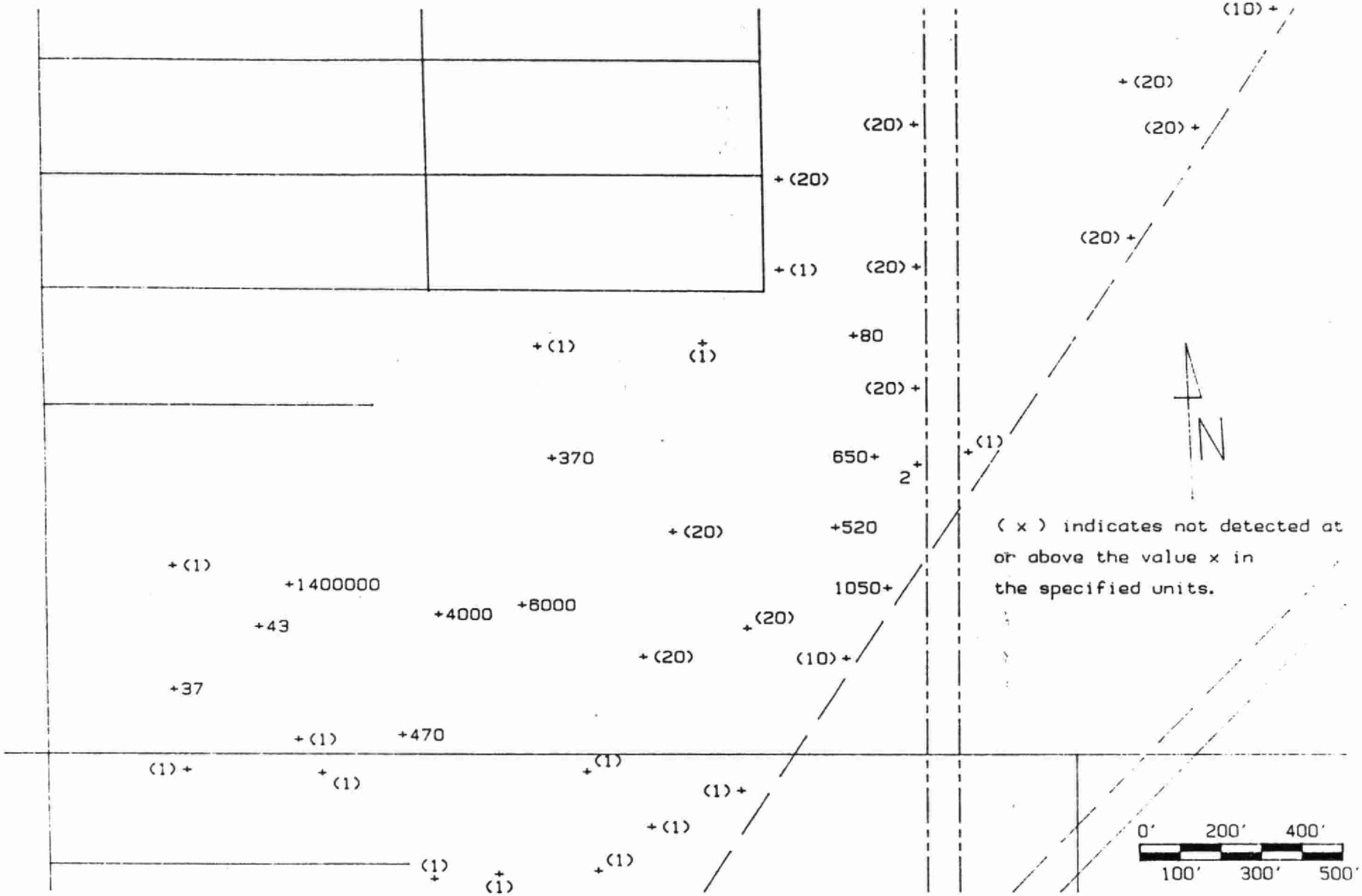

Figure 31: Average concentration of monochlorobenzene in ug/L at piezometers from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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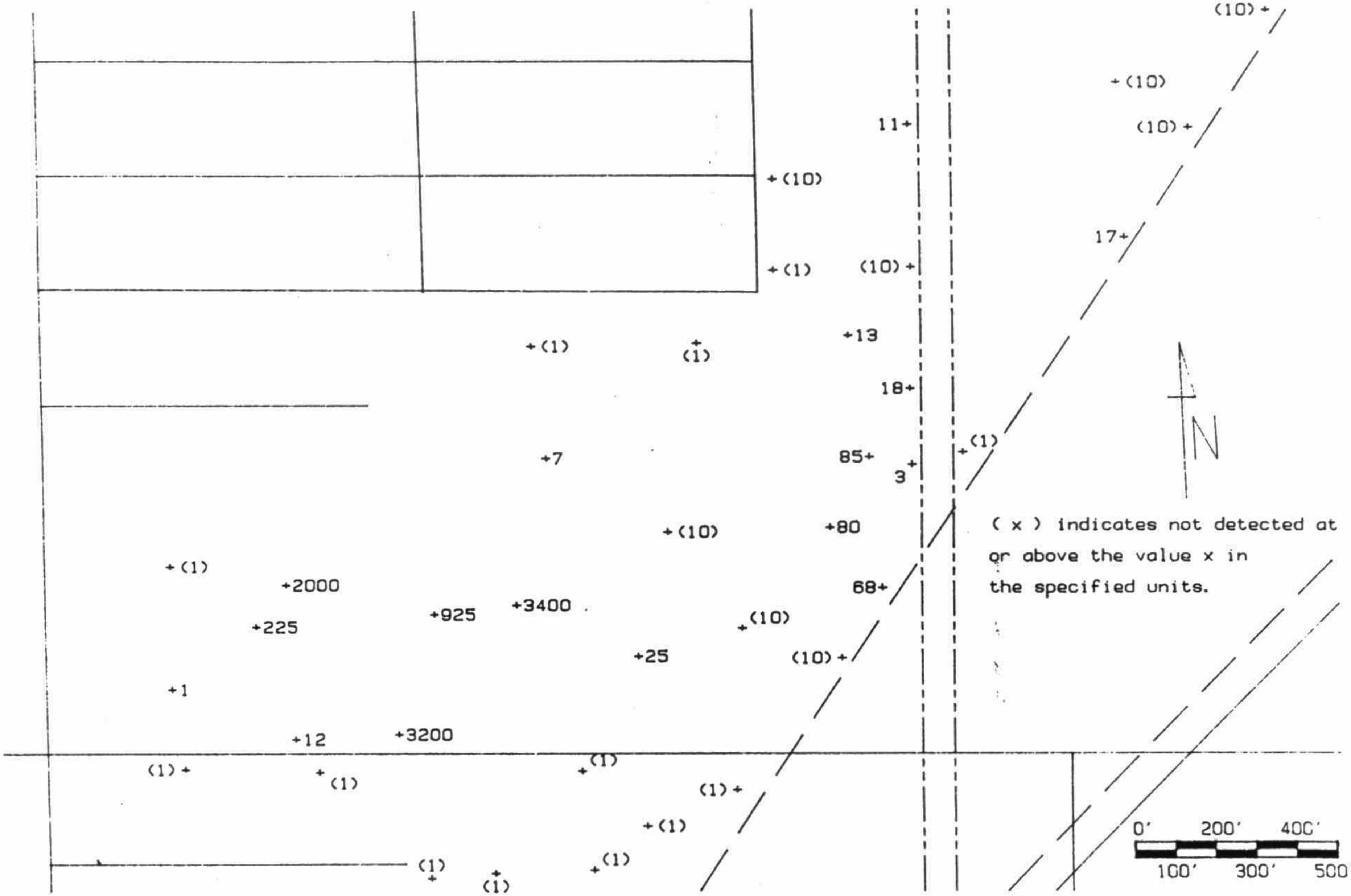

Figure 32: Average concentration of p-dichlorobenzene in ug/L at piezometers from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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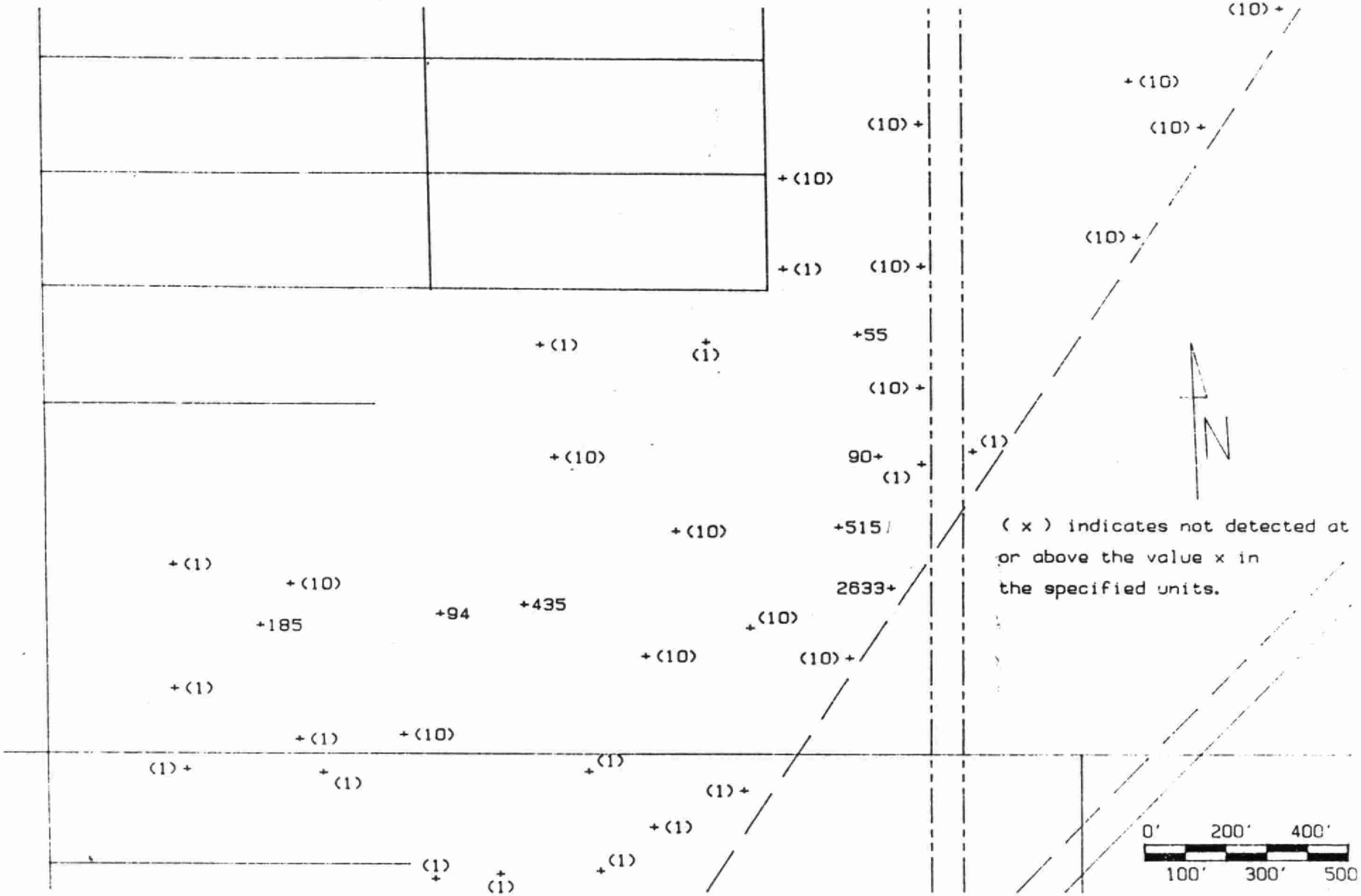

Figure 33: Average concentration of toluene in ug/L at piezometers from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

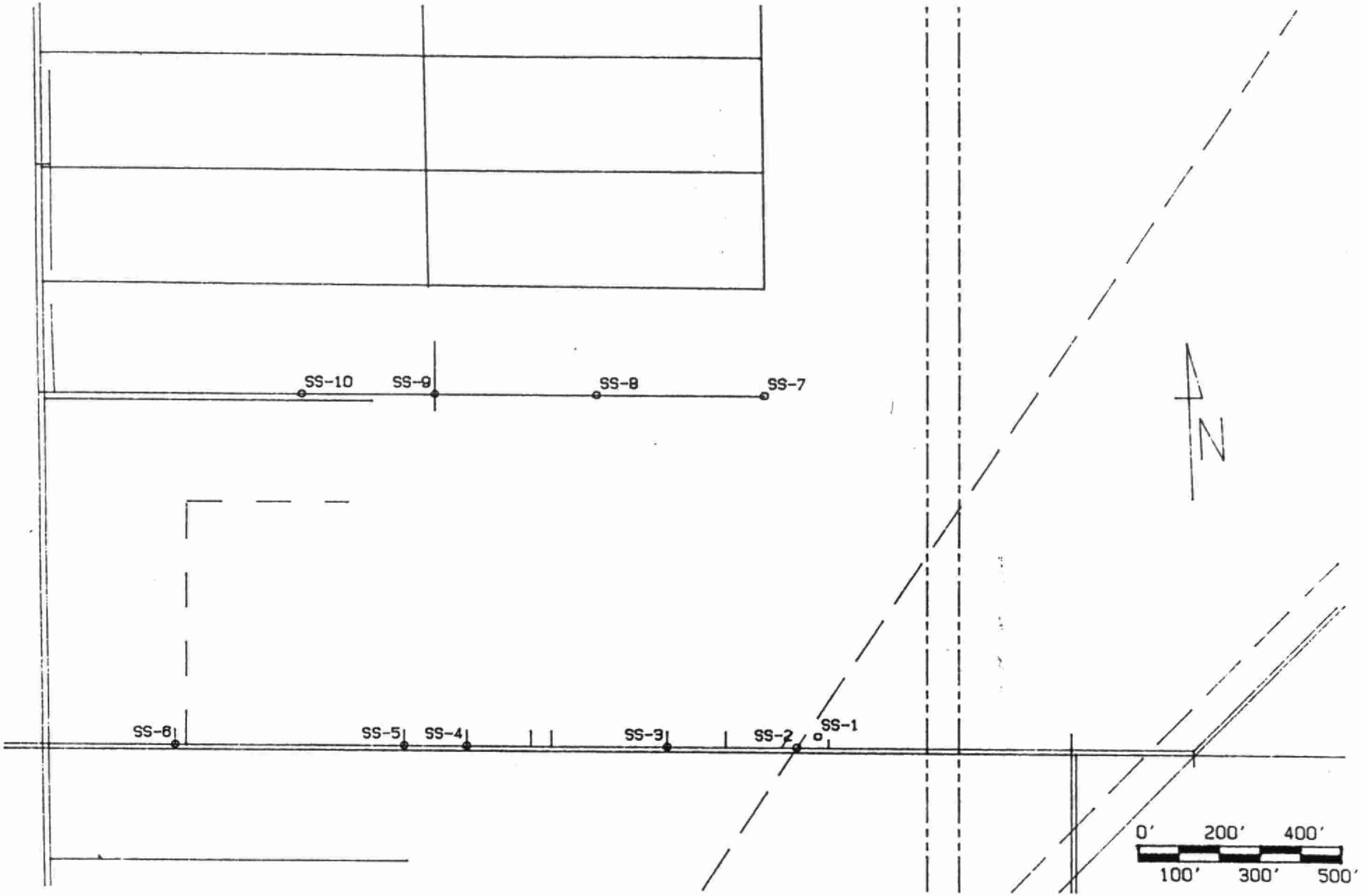

Figure 34: Location of Hooker (1980) storm sewer sampling points SS-1 through SS-10.

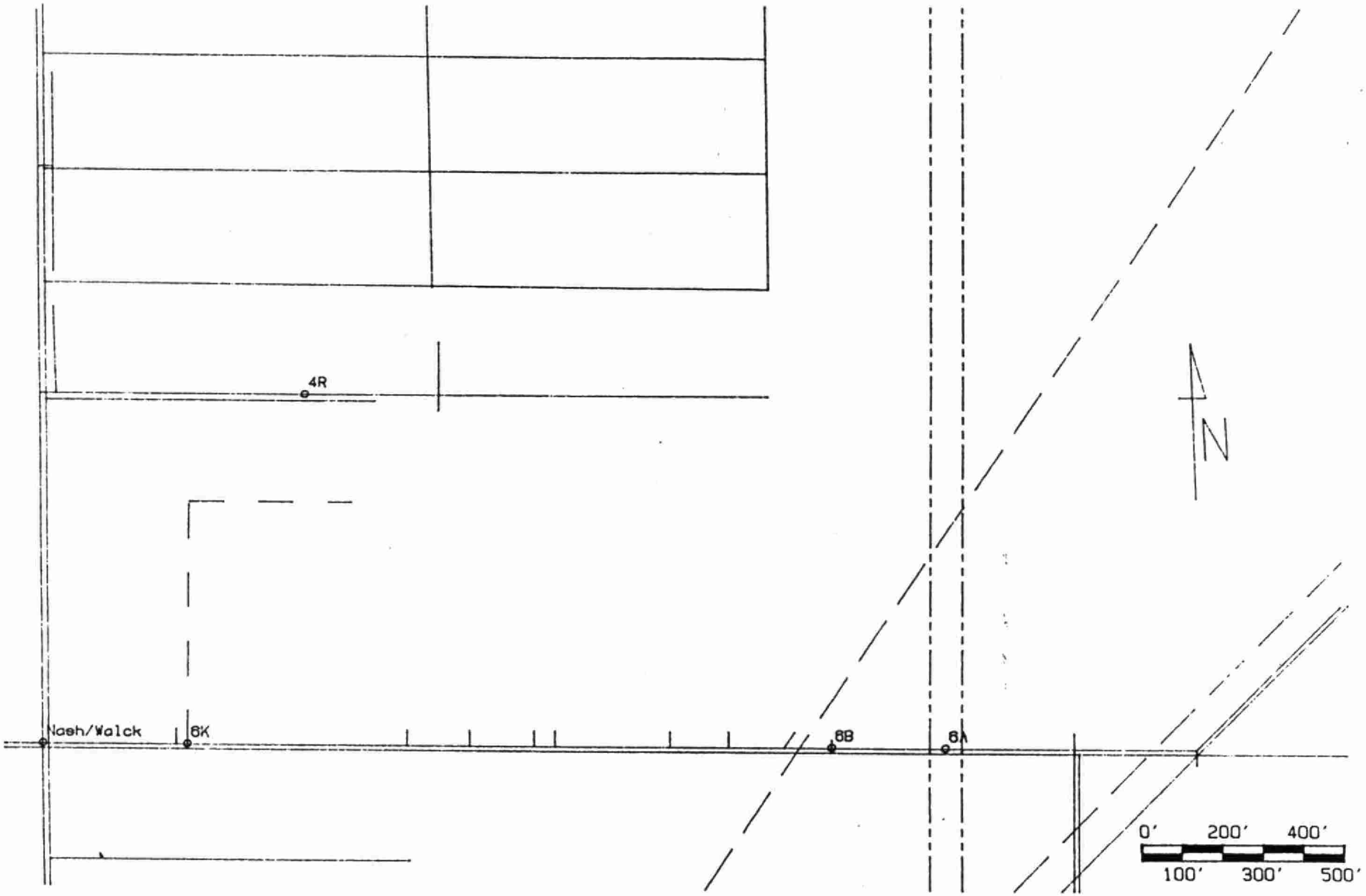

Figure 35: Location of Occidental (1982) and NYSDEC (1982b) storm sewer sampling points.

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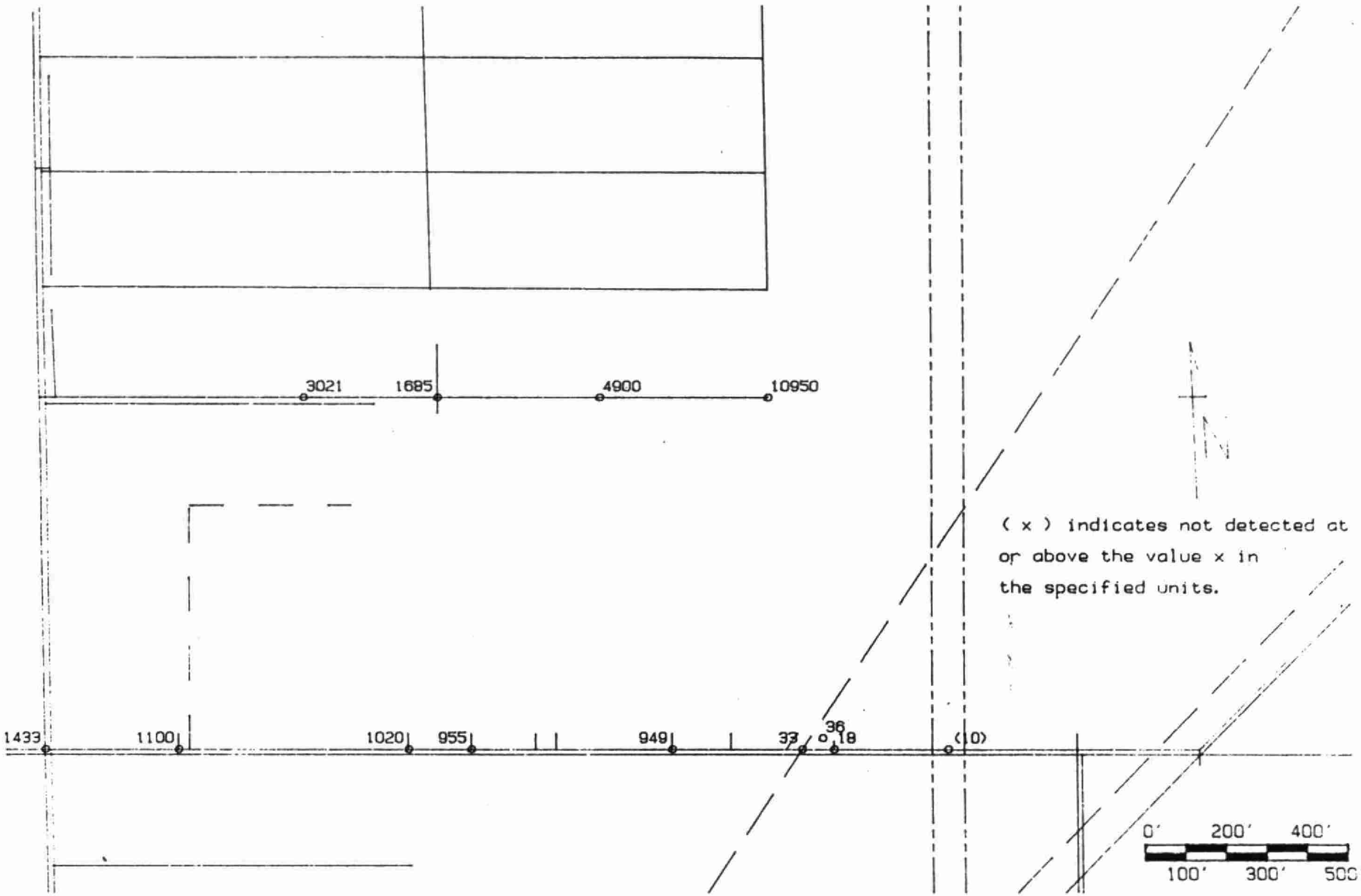

Figure 36: Average concentration of phenols in ug/L at sewer sampling points from Hooker (1980), Occidental (1982) and NYSDEC (1982b).

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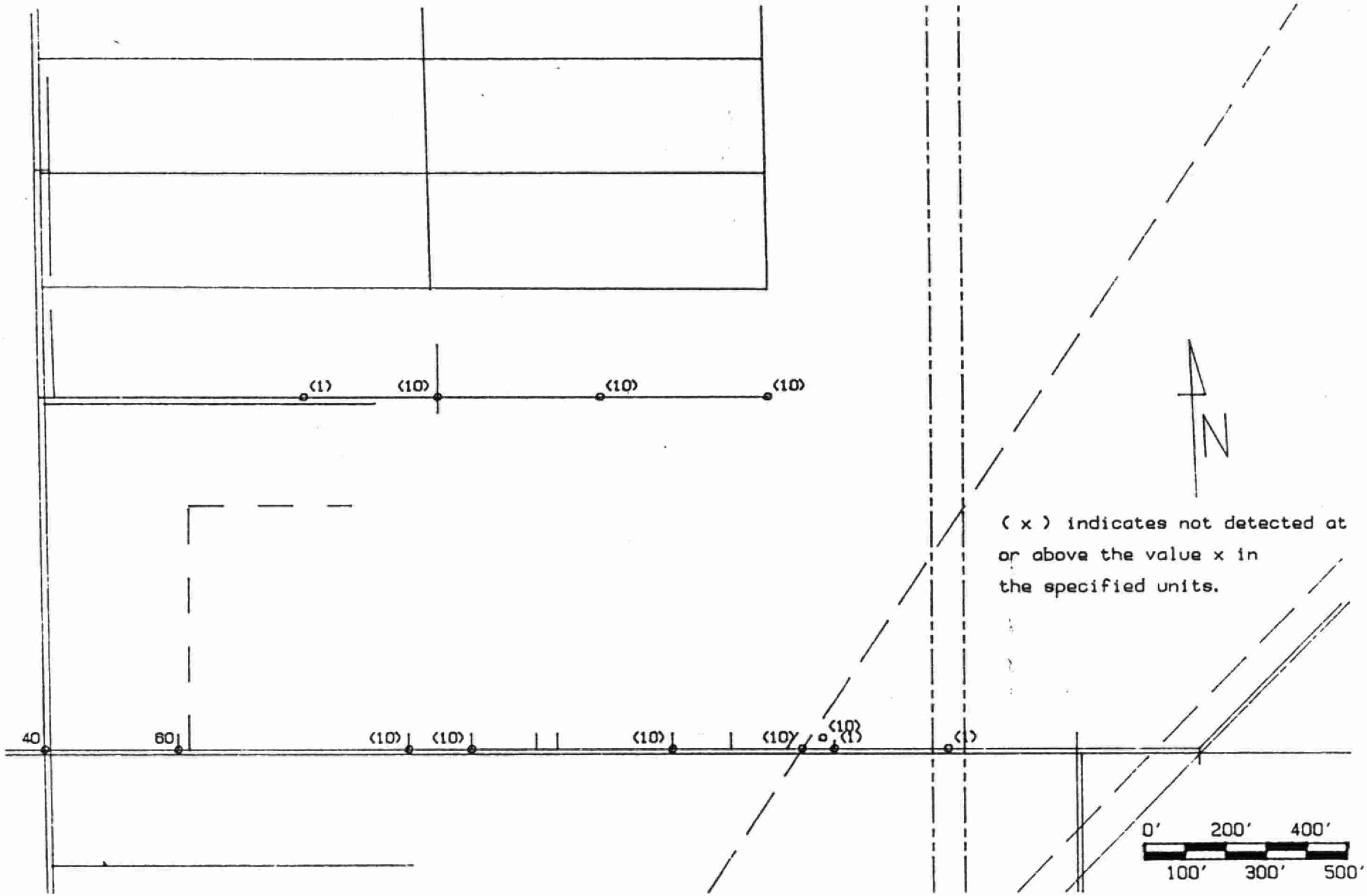

Figure 37: Average concentration of monochlorobenzene in ug/L at sewer sampling points from Hooker (1980), Occidental (1982) and NYSDEC (1982b).

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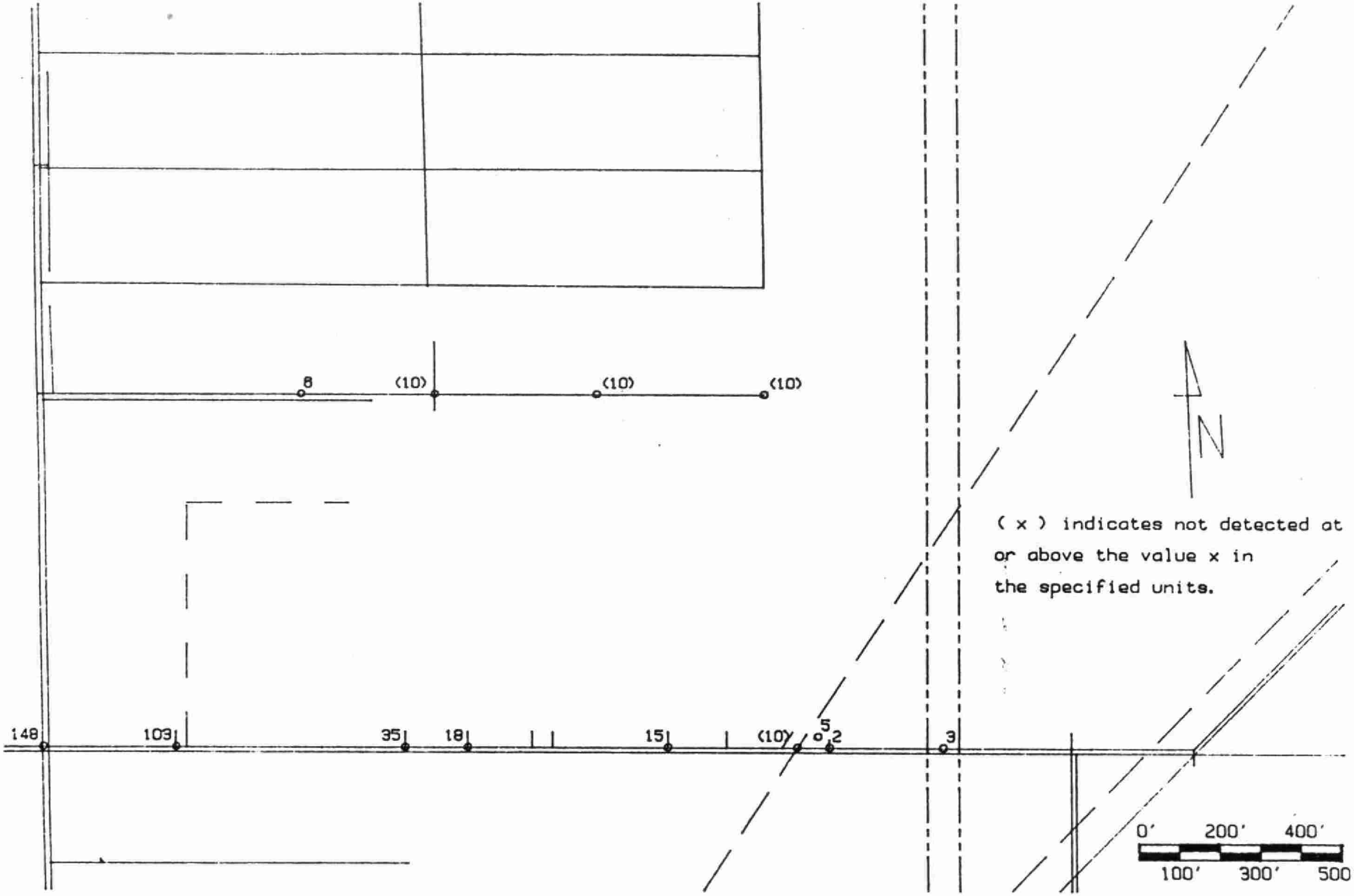

Figure 38: Average concentration of p-dichlorobenzene in ug/L at sewer sampling points from Hooker (1980), Occidental (1982) and NYSDEC (1982b).

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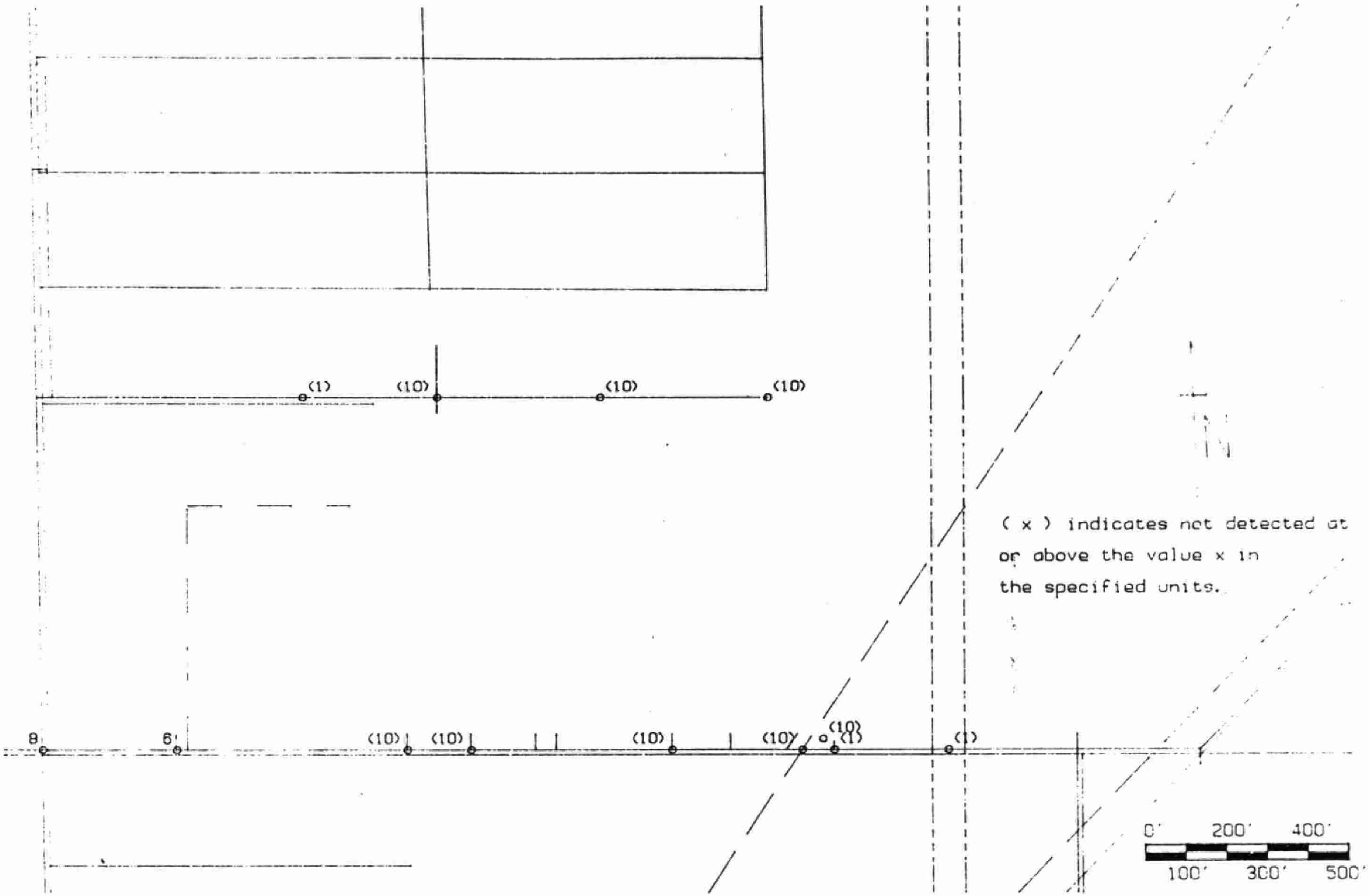

Figure 39: Average concentration of toluene in ug/L at sewer sampling points from Hooker (1980), Occidental (1982) and NYSDEC (1982b).

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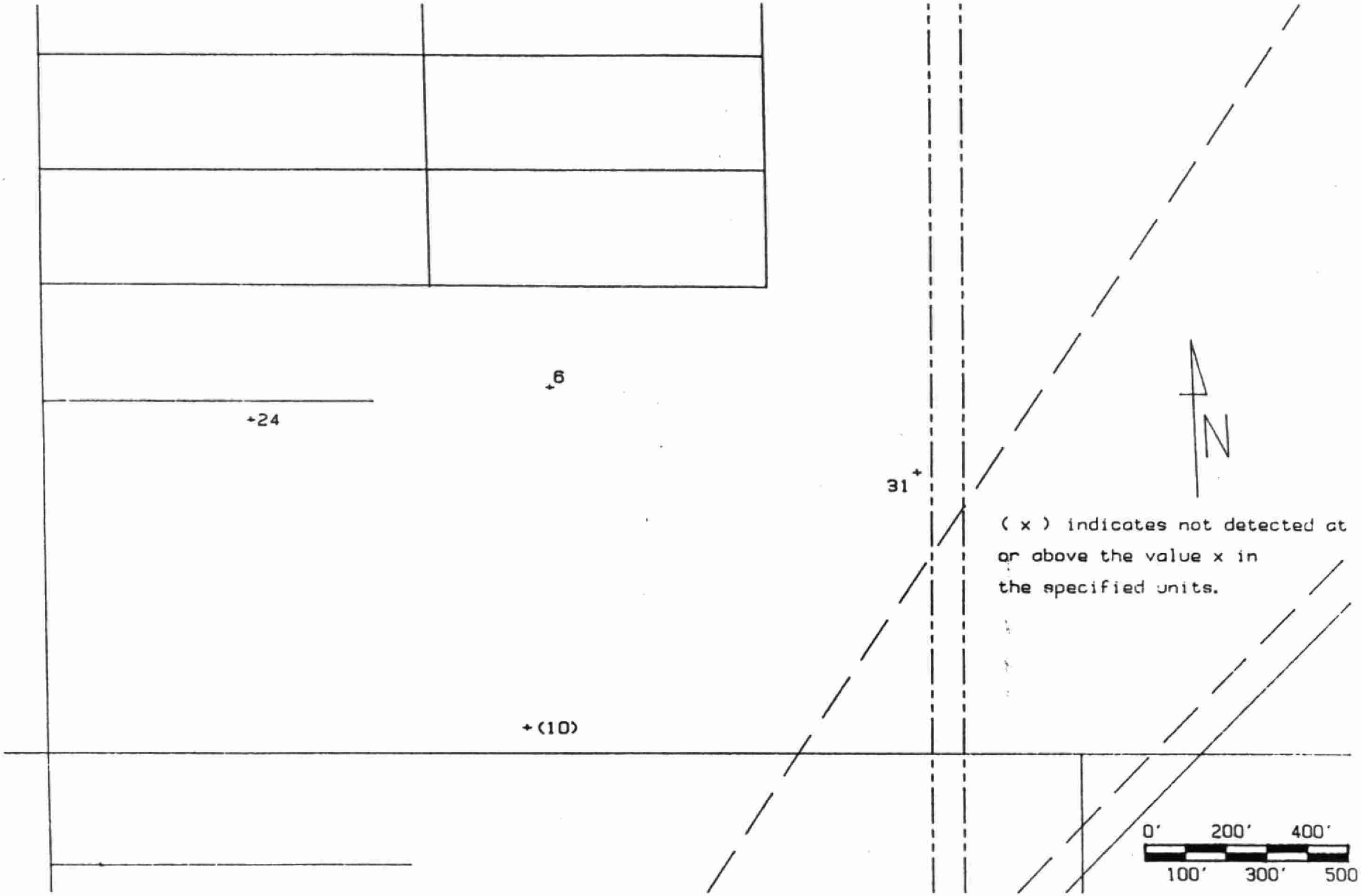

Figure 40: Average concentration of phenols in ug/L at deep wells from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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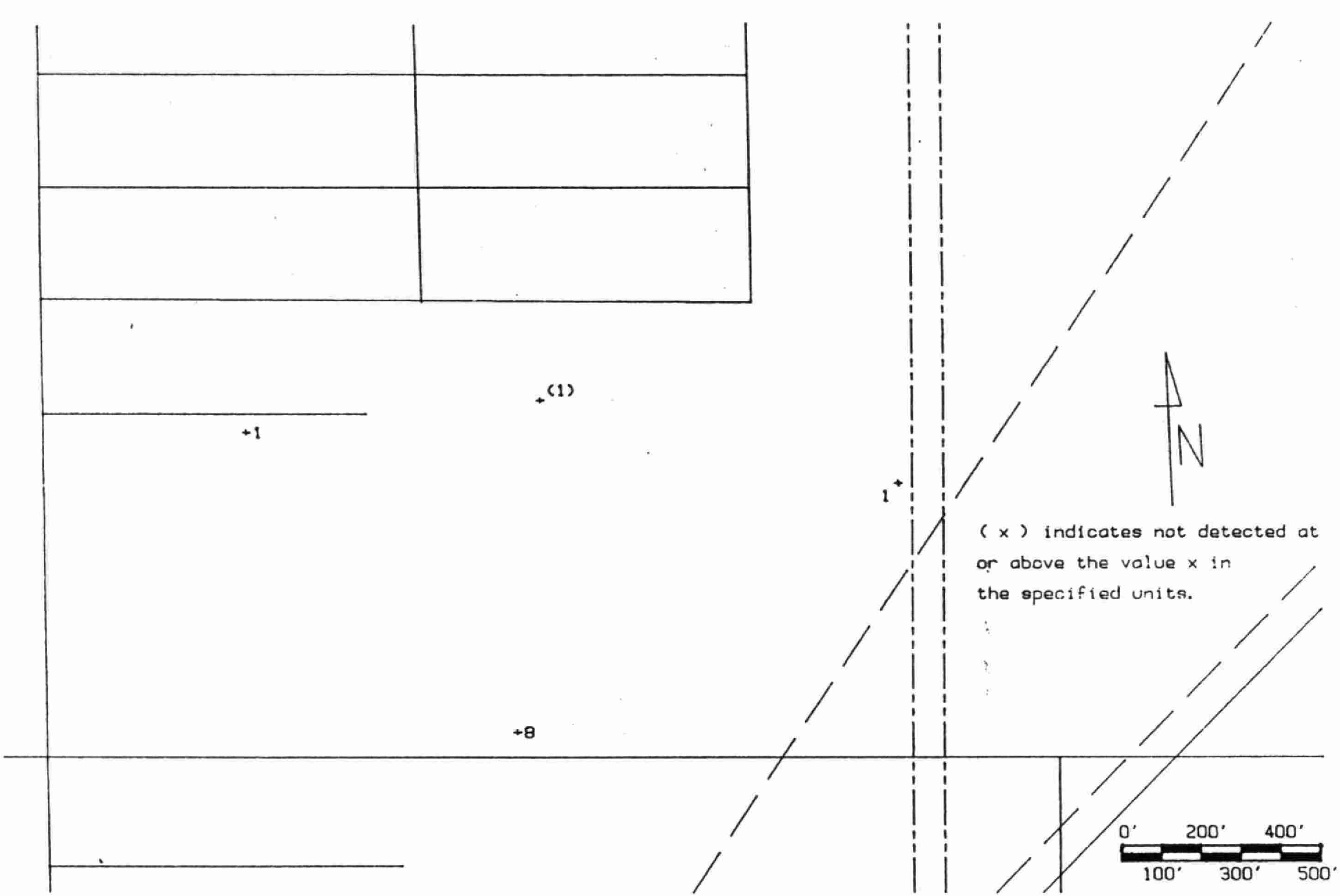

Figure 41: Average concentration of monochlorobenzene in ug/L at deep wells from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

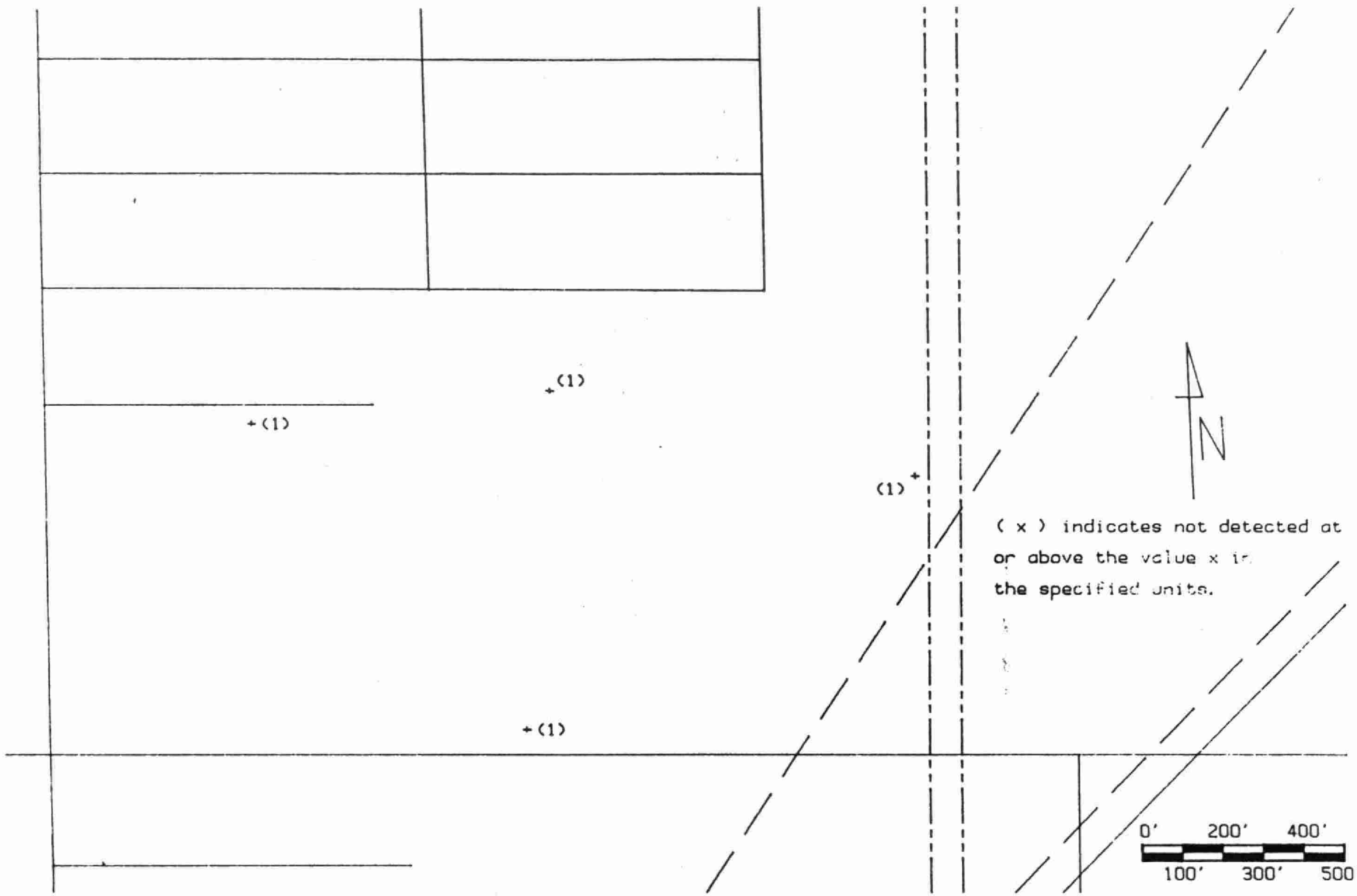

Figure 42: Average concentration of p-dichlorobenzene in ug/L at deep wells from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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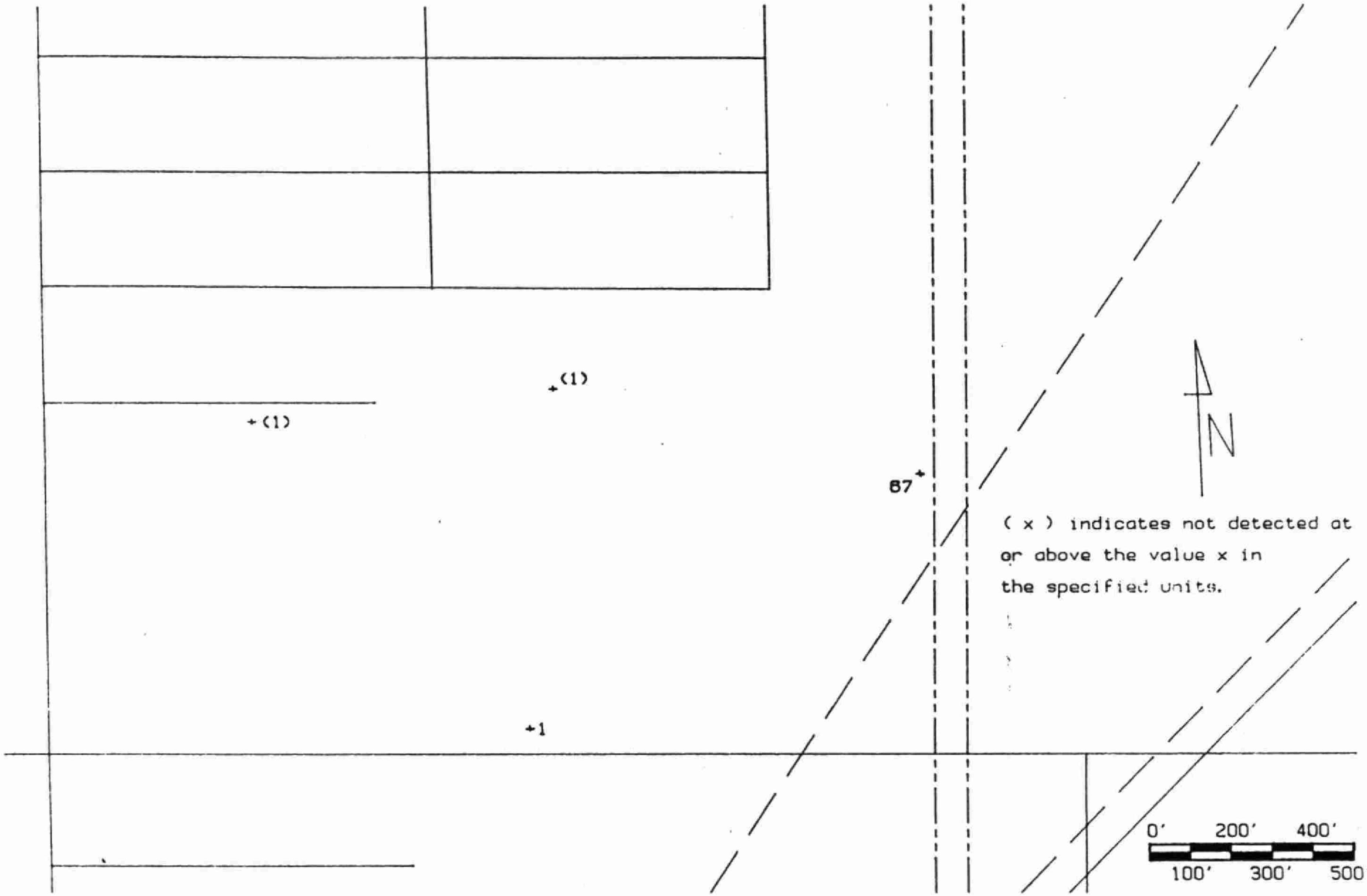

Figure 43: Average concentration of toluene in ug/L at deep wells from Hooker (1980), Occidental (1982) and NYSDEC (1982a).

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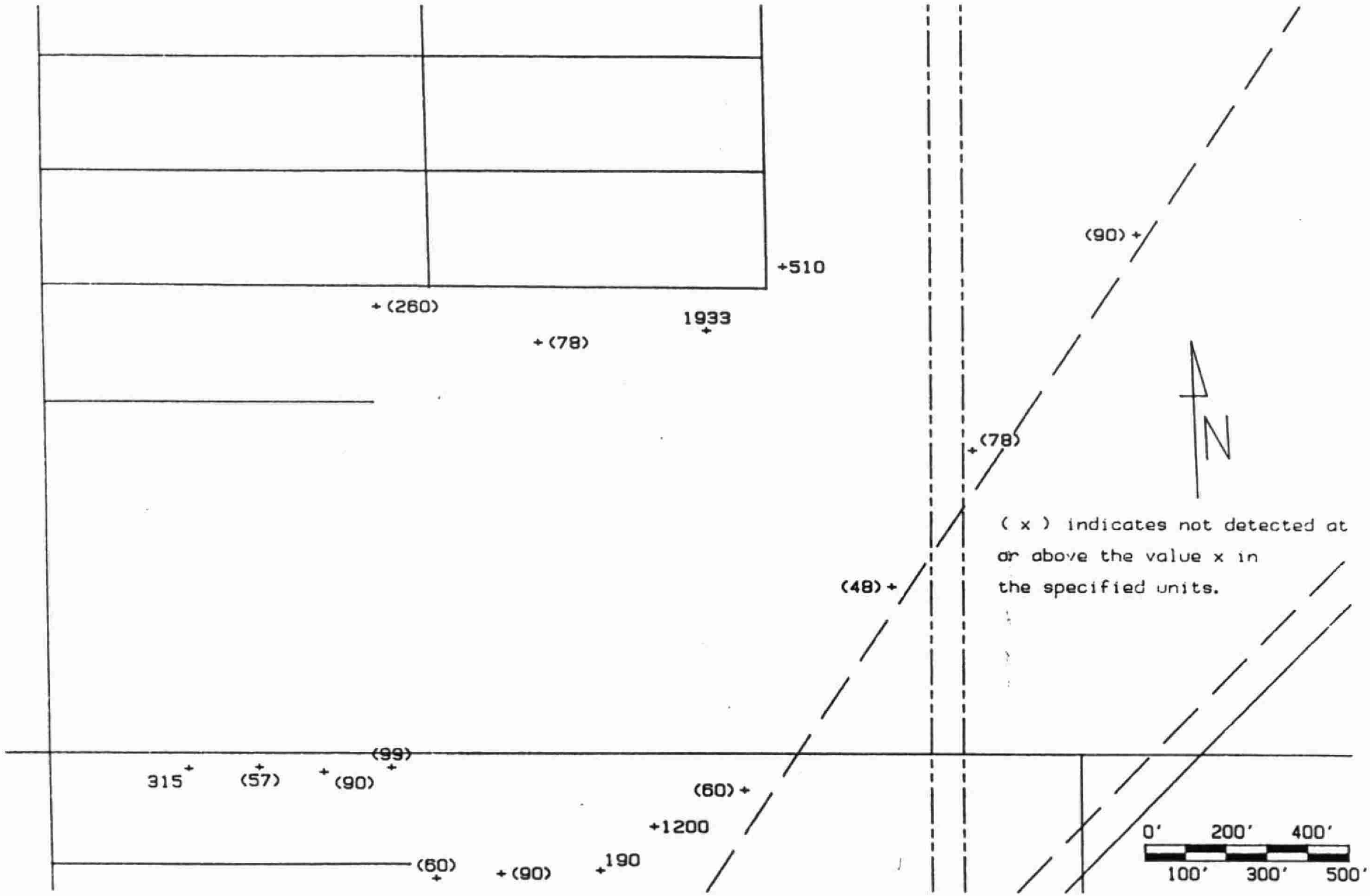

Figure 44: Average concentration of total TCDD in ng/L for soil borings from Occidental (1982).

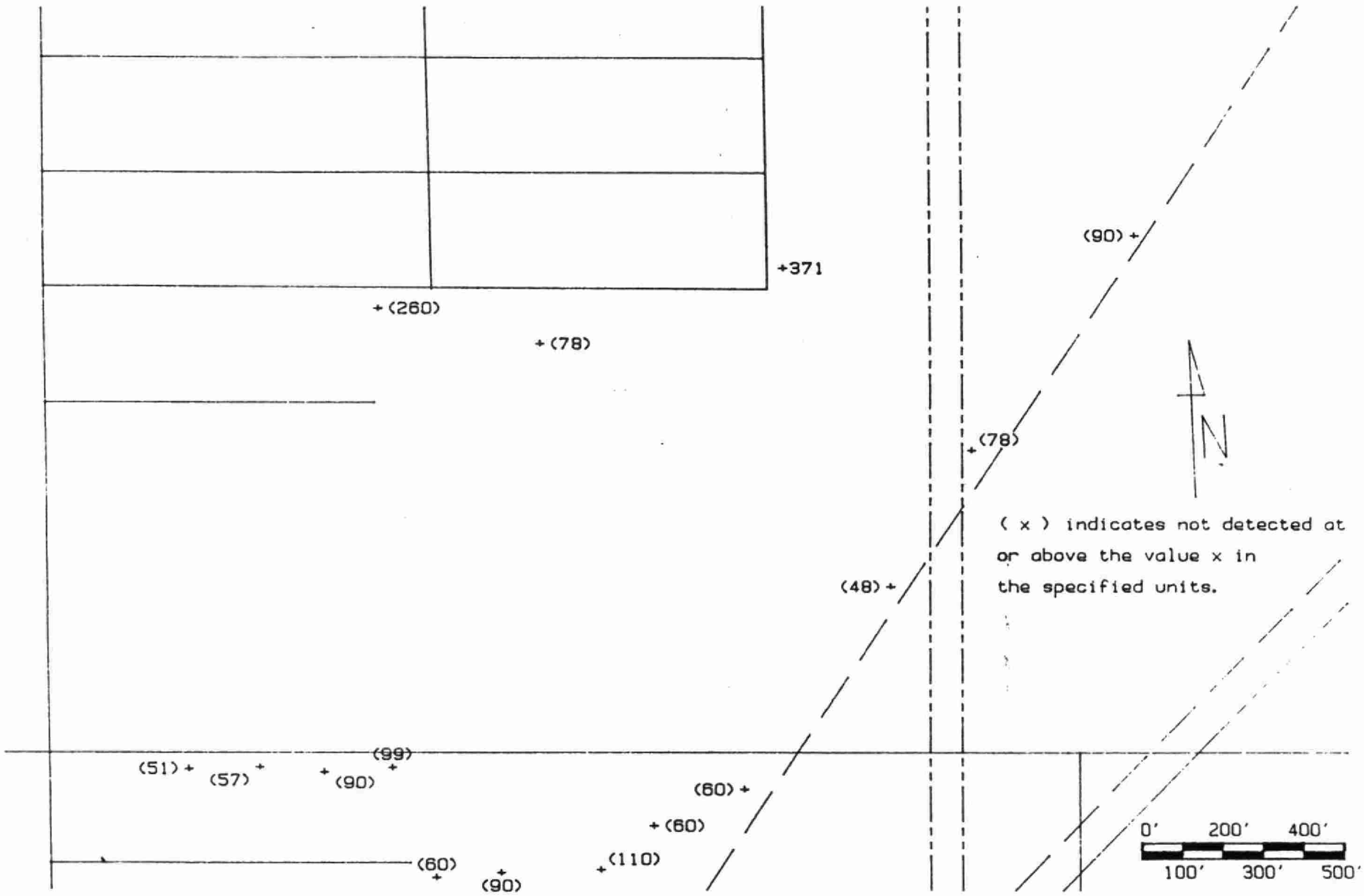

Figure 45: Average concentration of 2,3,7,8 TCDD (and co-eluting isomers) in ng/L for soil borings from Occidental (1982).

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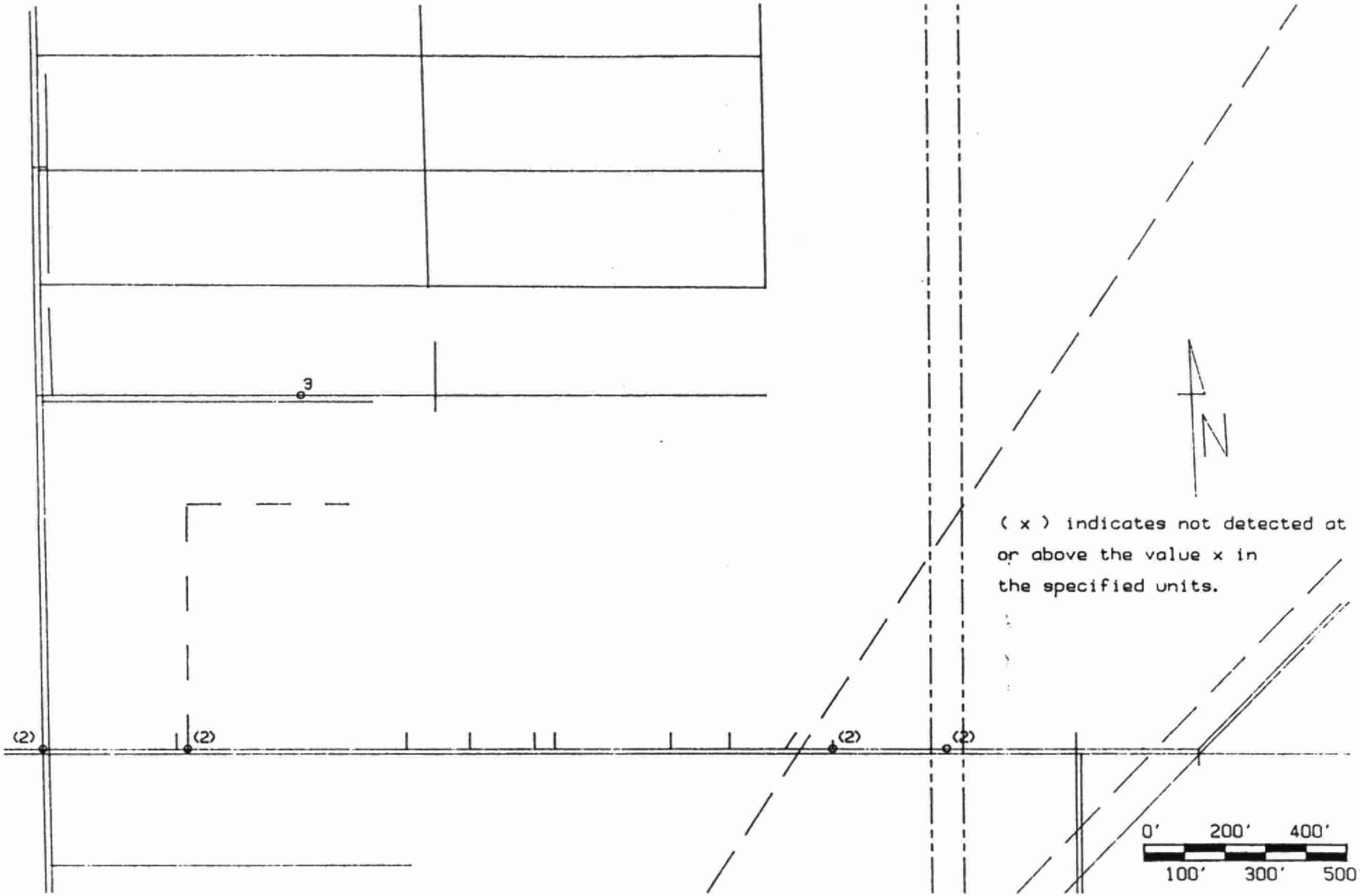

Figure 46: Average concentration of total TCDD in ng/L at sewer sampling points from Occidental (1982).

GTC

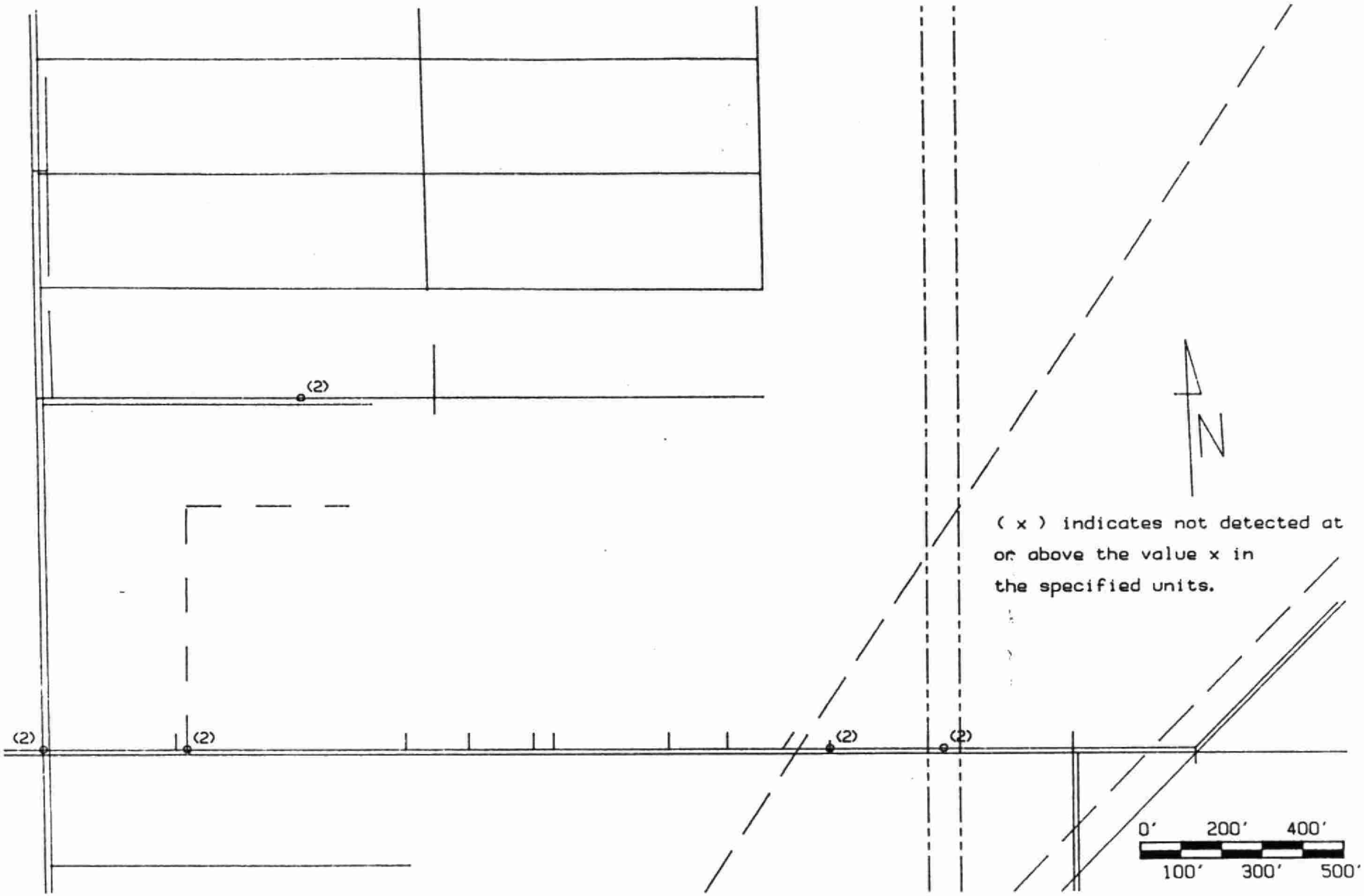

Figure 47: Average concentration of 2,3,7,8 TCDD (and co-eluting isomers) in ng/L at sewer sampling points from Occidental (1982).

APPENDIX I

Water Level Elevation Data

Piezometer	Measuring Point Elevation (feet)	01/10/80 bmp (feet)	01/10/80 elevation (feet)	01/15/80 bmp (feet)	01/15/80 elevation (feet)
P-1	101.84	4.75	97.09	4.50	97.34
P-2	101.38	7.08	94.30	6.83	94.55
P-3	101.69	4.25	97.44	3.92	97.77
P-4	101.23	7.08	94.15	7.04	94.19
P-5	101.58	5.92	95.66	5.58	96.00
P-6	100.73	7.00	93.73	6.96	93.77
P-7	100.74	5.83	94.91	6.67	94.07
P-8	103.95	8.00	95.95	7.83	96.12
P-9	102.65	6.17	96.48	5.83	96.82
P-10	103.18	7.17	96.01	6.58	96.60
P-11	104.15	3.63	100.53	3.42	100.73
P-12	104.19	6.38	97.82	6.33	97.86
P-13	102.76	4.75	98.01	4.17	98.59
P-14	103.72	5.67	98.05	5.04	98.68
P-15	102.48	4.75	97.73	4.17	98.31
P-16	101.09	3.00	98.09	2.75	98.34
P-17	101.47	2.83	98.64	2.33	99.14
P-18	101.82	3.67	98.15	3.63	98.20
P-19	103.73	8.96	94.77	8.63	95.11
P-20	102.20	7.67	94.53	7.42	94.78
P-21	100.58	3.79	96.79	3.00	97.58
P-22	---	---	---	---	---
P-23	102.61	4.58	98.03	4.25	98.36
P-24	101.12	4.21	96.91	3.42	97.70
P-25	101.69	4.50	97.19	3.71	97.98
P-26	102.71	5.08	97.63	4.75	97.96
P-27	101.89	4.00	97.89	2.75	99.14
P-28	---	---	---	---	---
P-29	101.98	5.17	96.81	4.00	97.98
P-30	103.20	4.92	98.28	4.50	98.70

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Hooker (1980)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Piezometer	Measuring Point Elevation (feet)	02/05/80 bmp (feet)	02/05/80 elevation (feet)	04/01/80 to 04/03/80 bmp (feet)	04/01/80 to 04/03/80 elevation (feet)
P-1	101.84	5.08	96.76	4.25	97.59
P-2	101.38	7.67	93.71	6.13	95.26
P-3	101.69	4.46	97.23	3.50	98.19
P-4	101.23	7.08	94.15	6.92	94.31
P-5	101.58	6.00	95.58	4.92	96.66
P-6	100.73	7.08	93.65	6.40	94.33
P-7	100.74	6.08	94.66	5.29	95.45
P-8	103.95	8.46	95.49	7.17	96.78
P-9	102.65	6.25	96.40	5.33	97.32
P-10	103.18	7.42	95.76	5.71	97.47
P-11	104.15	3.46	100.69	3.38	100.78
P-12	104.19	6.42	97.77	6.67	97.52
P-13	102.76	5.33	97.43	3.75	99.01
P-14	103.72	6.00	97.72	4.42	99.30
P-15	102.48	5.08	97.40	3.67	98.81
P-16	101.09	2.83	98.26	2.58	98.51
P-17	101.47	3.17	98.30	2.42	99.05
P-18	101.82	3.67	98.15	3.33	98.49
P-19	103.73	9.42	94.31	7.63	96.11
P-20	102.20	7.92	94.28	6.83	95.37
P-21	100.58	4.17	96.41	3.08	97.50
P-22	---	---	---	---	---
P-23	102.61	5.04	97.57	4.17	98.44
P-24	101.12	4.63	96.50	2.38	98.75
P-25	101.69	4.79	96.90	3.13	98.57
P-26	102.71	5.25	97.46	4.46	98.25
P-27	101.89	4.71	97.18	2.08	99.81
P-28	---	---	---	---	---
P-29	101.98	5.46	96.52	3.92	98.06
P-30	103.20	5.50	97.70	4.50	98.70

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Hooker (1980)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Piezometer	Measuring Point Elevation (feet)	06/17/80 and 06/18/80 bmp (feet)	elevation (feet)
P-1	101.84	4.83	97.01
P-2	101.38	6.79	94.59
P-3	101.69	3.88	97.82
P-4	101.23	7.08	94.15
P-5	101.58	5.75	95.83
P-6	100.73	---	---
P-7	100.74	5.67	95.07
P-8	103.95	7.92	96.03
P-9	102.65	---	---
P-10	103.18	7.38	95.81
P-11	104.15	3.71	100.44
P-12	104.19	6.29	97.90
P-13	102.76	5.00	97.76
P-14	103.72	5.58	98.14
P-15	102.48	4.83	97.65
P-16	101.09	3.83	97.26
P-17	101.47	4.25	97.22
P-18	101.82	---	---
P-19	103.73	8.92	94.81
P-20	102.20	---	---
P-21	100.58	---	---
P-22	---	---	---
P-23	102.61	---	---
P-24	101.12	4.71	96.41
P-25	101.69	5.33	96.36
P-26	102.71	4.83	97.88
P-27	101.89	---	---
P-28	---	---	---
P-29	101.98	---	---
P-30	103.20	---	---

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Hooker (1980)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Piezometer	Measuring Point Elevation (feet)	06/22/82 bmp (feet)	06/22/82 elevation (feet)	08/17/82 bmp (feet)	08/17/82 elevation (feet)
P-1	101.84	4.65	97.19	5.69	96.15
P-2	101.38	6.63	94.75	7.01	94.37
P-3	101.69	3.81	97.88	4.19	97.50
P-4	101.23	6.98	94.25	7.07	94.16
P-5	101.58	5.62	95.96	5.95	95.63
P-6	100.73	---	---	6.49	94.24
P-7	100.74	5.77	94.97	5.89	94.85
P-8	103.95	7.98	95.97	8.11	95.84
P-9	102.65	5.62	97.03	5.92	96.73
P-10	103.18	7.19	95.99	8.06	95.12
P-11	104.15	4.68	99.47	4.32	99.83
P-12	104.19	6.03	98.16	6.13	98.06
P-13	102.76	4.81	97.95	5.64	97.12
P-14	103.72	5.52	98.20	6.19	97.53
P-15	102.48	4.50	97.98	5.55	96.93
P-16	101.09	2.87	98.22	4.42	96.67
P-17	101.47	2.93	98.54	5.71	95.76
P-18	101.82	3.37	98.45	7.37	94.45
P-19	103.73	8.71	95.02	9.13	94.60
P-20	102.20	7.59	94.61	7.78	94.42
P-21	100.58	3.87	96.71	Dry	(95.58)
P-22	---	---	---	---	---
P-23	102.61	4.89	97.72	Dry	(98.61)
P-24	101.12	4.43	96.69	Dry	(94.12)
P-25	101.69	4.77	96.92	Dry	(95.19)
P-26	102.71	4.68	98.03	5.42	97.29
P-27	101.89	5.25	96.64	8.28	93.61
P-28	---	---	---	---	---
P-29	101.98	5.25	96.73	7.12	94.86
P-30	103.20	5.44	97.76	8.44	94.76
P-31	102.13	8.33	93.80	8.84	93.29
P-32	---	---	---	---	---
P-33	101.45	5.15	96.30	Dry	(94.35)
P-34	100.97	5.94	95.03	8.87	92.10
P-35	100.63	6.60	94.03	Dry	Dry
P-36	100.94	7.15	93.79	Dry	(93.44)

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Dunn Geoscience (1983)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Note: (x) denotes that x is the maximum elevation possible (elevation of bottom of well screen)

Piezometer	Measuring Point Elevation (feet)	06/22/82 bmp (feet)	06/22/82 elevation (feet)	08/17/82 bmp (feet)	08/17/82 elevation (feet)
NP-1	100.85	8.06	92.79	Dry	(94.35)
NP-2	101.28	6.84	94.44	8.65	92.63
NP-3	103.73	7.29	96.44	8.44	95.29
NP-4	101.12	6.05	95.07	8.50	92.62
NP-5	99.62	5.98	93.64	7.97	91.65
NP-6	98.99	4.13	94.86	6.23	92.76
NP-7	101.14	3.57	97.57	7.49	93.65
NP-8	101.21	3.65	97.56	6.84	94.37
NP-9	101.92	6.04	95.88	8.97	92.95
NP-10	103.74	7.37	96.37	8.67	95.07
NP-11	101.80	4.68	97.12	7.65	94.15
SWP-9	102.23	7.21	95.02	7.88	94.35

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Dunn Geoscience (1983)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Note: (x) denotes that x is the maximum elevation possible (elevation of bottom of well screen)

Well	Measuring Point Elevation (feet)	02/05/80 bmp (feet)	02/05/80 elevation (feet)	04/01/80 to 04/03/80 bmp (feet)	04/01/80 to 04/03/80 elevation (feet)
W-7	104.51	14.66	89.85	15.00	89.51
W-12	102.80	13.08	89.72	13.04	89.76
W-16	103.92	14.00	89.92	14.50	89.42
W-17	101.38	11.75	89.63	11.83	89.55

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - Hooker (1980)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

Well	Measuring Point Elevation (feet)	06/17/80 and 06/18/80 bmp (feet)	06/17/80 and 06/18/80 elevation (feet)	06/22/82 bmp (feet)	06/22/82 elevation (feet)
W-7	104.51	15.33	89.18	15.01	89.50
W-12	102.80	13.71	89.09	13.32	89.48
W-16	103.92	15.33	88.59	14.46	89.46
W-17	101.38	11.92	89.46	11.89	89.49

Data sources: Measuring Point Elevation - Dunn Geoscience (1983)
bmp measurements - 06/17/80 and 06/18/80 - Hooker (1980)
- 06/22/82 - Dunn Geoscience (1983)

All elevations reference to Hooker Benchmark #2 at 101.08 feet

APPENDIX II

CHEMICAL ANALYSIS RESULTS

APPENDIX IIa

Analysis Results for Water Samples
From Shallow Piezometers P-1 Through
P-36 and NP-1 Through NP-11

NOTE: The only date available from Occidental (1982) was "Summer 1982". Dates for Occidental (1982) data were assigned on the basis that the samples analyzed were split samples also analyzed by NYSDEC (1982a) for which sampling dates are available. If no NYSDEC (1982a) analysis was available for a specific piezometer, the date "Summer 1982" is used for Occidental (1982) data.

Sample Point Sample Date Data Source		P-1 04/04/80 Hooker (1980)	P-1 06/18/80 Hooker (1980)	P-2 04/04/80 Hooker (1980)	P-2 06/18/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	80	290	ND(10)	ND(10)
Monochlorobenzene	ug/L	ND(20)	85	ND(20)	ND(10)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	190	160	22	13
m-Dichlorobenzene	ug/L	32	62	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	170	280	29	18
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	23	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	4300	2300	23	15
pH	-	8.90	7.68	-	7.44
Conductivity	u mhos/cm	1290	970	-	2080

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

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Sample Point / Sample Date / Data Source	Units	P-2 07/15/82 Occidental (1982)	P-2 07/15/82 NYSDEC (1982a)	P-3 04/04/80 Hooker (1980)	P-3 06/17/80 Hooker (1980)
o-Chlorophenol	ug/L	ND(10)	ND(10)	-	-
p-Chlorophenol	ug/L	ND(10)	ND(10)	-	-
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	-	-
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(10)	-	-
Benzene	ug/L	ND(1)	ND(1)	-	-
Toluene	ug/L	ND(1)	ND(1)	ND(10)	ND(10)
Monochlorobenzene	ug/L	ND(1)	ND(1)	-	1400000
o-Chlorotoluene	ug/L	ND(1)	ND(1)	-	-
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	2600	1500
m-Dichlorobenzene	ug/L	-	-	780	350
p-Dichlorobenzene	ug/L	2	ND(1)	2200	1800
1,2,3-Trichlorobenzene	ug/L	-	ND(1)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	-	ND(1)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	-	-	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	ND(1)	-	-	-
TOC	ug/mL	82	-	-	-
Chloride	mg/L	2400	-	-	-
TDS	mg/L	4400	-	-	-
Phenols	ug/L	ND(100)	-	490	710
pH	-	6.60	-	9.80	7.99
Conductivity	u mhos/cm	7500	-	2010	2810

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source	Units	P-4 04/02/80 Hooker (1980)	P-4 06/18/80 Hooker (1980)	P-5 04/02/80 Hooker (1980)	P-5 06/18/80 Hooker (1980)
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	ND(10)	ND(10)	98	89
Monochlorobenzene	ug/L	ND(20)	940	-	4000
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	2300	3200	2300	430
m-Dichlorobenzene	ug/L	770	2000	330	52
p-Dichlorobenzene	ug/L	1400	5000	1500	350
1,2,3-Trichlorobenzene	ug/L	370	200	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	680	1100	ND(10)	20
1,3,5-Trichlorobenzene	ug/L	27	46	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	220	25	340	620
pH	-	7.02	7.76	12.46	12.37
Conductivity	u mhos/cm	1310	1380	8410	7450

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source	Units	P-7 04/04/80 Hooker (1980)	P-7 06/17/80 Hooker (1980)	P-8 04/04/80 Hooker (1980)	P-8 06/17/80 Hooker (1980)
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	190	680	ND(10)	-
Monochlorobenzene	ug/L	ND(20)	12000	ND(20)	-
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	1000	3200	ND(10)	-
m-Dichlorobenzene	ug/L	200	1100	ND(10)	-
p-Dichlorobenzene	ug/L	1300	5500	ND(10)	-
1,2,3-Trichlorobenzene	ug/L	33	ND(10)	ND(10)	-
1,2,4-Trichlorobenzene	ug/L	34	910	ND(10)	-
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	190000	44000	24	-
pH	-	7.61	7.81	-	6.75*
Conductivity	u mhos/cm	3640	2250	-	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source	Units	P-9 04/01/80 Hooker (1980)	P-10 04/04/80 Hooker (1980)	P-10 06/17/80 Hooker (1980)	P-11 04/01/80 Hooker (1980)
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	ND(10)	ND(10)	ND(10)	480
Monochlorobenzene	ug/L	ND(20)	ND(20)	ND(10)	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	17
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	16
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	25
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	210	22	18	64000
pH	-	6.91	7.68	7.68	8.27
Conductivity	u mhos/cm	5100	936	870	679

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point Sample Date Data Source		P-11 06/17/80 Hooker (1980)	P-11 06/30/82 Occidental (1982)	P-11 06/30/82 NYSDEC (1982a)	P-12 04/02/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	59	10	-
p-Chlorophenol	ug/L	-	81	77	-
2,4,5-Trichlorophenol	ug/L	-	ND(10)	ND(10)	-
2,4,6-Trichlorophenol	ug/L	-	10	ND(10)	-
Benzene	ug/L	-	18	13	-
Toluene	ug/L	1100	290	190	180
Monochlorobenzene	ug/L	460	740	880	ND(20)
o-Chlorotoluene	ug/L	-	ND(1)	5	-
o-Dichlorobenzene	ug/L	76	160	41	54
m-Dichlorobenzene	ug/L	ND(10)	-	-	21
p-Dichlorobenzene	ug/L	26	200	69	170
1,2,3-Trichlorobenzene	ug/L	ND(10)	-	6.7	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	-	17	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	-	-	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	28	-	-
TOC	ug/mL	-	108	-	-
Chloride	mg/L	-	24	-	-
TDS	mg/L	-	350	-	-
Phenols	ug/L	190000	49500	-	1100
pH	-	7.87	6.35	-	7.32
Conductivity	u mhos/cm	452	525	-	2900

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

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Sample Point Sample Date Data Source	P-12 06/18/80 Hooker (1980)	P-13 04/02/80 Hooker (1980)	P-13 06/17/80 Hooker (1980)	P-14 04/02/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	ND(10)	ND(10)	-	ND(10)
Monochlorobenzene	ug/L	1300	ND(20)	-	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	29	-	ND(10)
p-Dichlorobenzene	ug/L	ND(10)	18	-	12
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	29000	21	-	98
pH	-	7.49	7.47	6.75*	12.34
Conductivity	u mhos/cm	1810	1180	-	5620

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

GTC

Sample Point Sample Date Data Source	P-14 06/18/80 Hooker (1980)	P-14 07/01/82 Occidental (1982)	P-14 07/01/82 NYSDEC (1982a)	P-15 04/02/80 Hooker (1980)
Units				

	Units				
o-Chlorophenol	ug/L	-	ND(10)	ND(10)	-
p-Chlorophenol	ug/L	-	ND(10)	ND(10)	-
2,4,5-Trichlorophenol	ug/L	-	ND(10)	ND(10)	-
2,4,6-Trichlorophenol	ug/L	-	ND(10)	ND(10)	-
Benzene	ug/L	-	ND(1)	33	-
Toluene	ug/L	ND(10)	ND(1)	ND(1)	ND(10)
Monochlorobenzene	ug/L	ND(10)	4	4	ND(20)
o-Chlorotoluene	ug/L	-	2	3	-
o-Dichlorobenzene	ug/L	ND(10)	25	1	58
m-Dichlorobenzene	ug/L	ND(10)	-	-	25
p-Dichlorobenzene	ug/L	ND(10)	ND(1)	1	25
1,2,3-Trichlorobenzene	ug/L	ND(10)	-	ND(1)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	-	ND(1)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	-	-	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	4	-	-
TOC	ug/mL	-	22	-	-
Chloride	mg/L	-	70	-	-
TDS	mg/L	-	350	-	-
Phenols	ug/L	58	ND(100)	-	130
pH	-	12.04	6.20	-	7.69
Conductivity	u mhos/cm	3270	600	-	4800

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point Sample Date Data Source		P-15 06/18/80 Hooker (1980)	P-16 04/02/80 Hooker (1980)	P-16 06/17/80 Hooker (1980)	P-17 04/02/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	110	ND(10)	-	ND(10)
Monochlorobenzene	ug/L	160	ND(20)	-	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	11
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	480	49	-	13
pH	-	7.36	12.57	11.90*	12.49
Conductivity	u mhos/cm	4890	10300	-	8640

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point Sample Date Data Source		P-17 06/17/80 Hooker (1980)	P-19 04/04/80 Hooker (1980)	P-19 06/18/80 Hooker (1980)	P-20 04/02/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	-	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(20)	740	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	-	ND(10)	46	37
m-Dichlorobenzene	ug/L	-	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	-	ND(10)	14	25
1,2,3-Trichlorobenzene	ug/L	-	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	-	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	-	ND(10)	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	-	65	207	37
pH	-	12.10*	7.14	7.19	7.73
Conductivity	u mhos/cm	-	7200	5700	1770

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point Sample Date Data Source		P-21 04/02/80 Hooker (1980)	P-22 04/02/80 Hooker (1980)	P-22 06/17/80 Hooker (1980)	P-23 04/02/80 Hooker (1980)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	ND(20)	ND(20)	ND(10)	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	52	ND(10)	ND(10)	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	17	ND(10)	ND(10)	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	28	47	31	16
pH	-	7.41	8.23	7.49	7.71
Conductivity	u mhos/cm	1710	1220	1510	1240

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source		P-24 04/01/80 Hooker (1980)	P-24 06/17/80 Hooker (1980)	P-24 06/28/82 Occidental (1982)	P-24 06/28/82 NYSDEC (1982a)
	Units				
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	35.5	180
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	26	11
Toluene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(20)	ND(10)	105	42
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	2	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	-
TOC	ug/mL	-	-	73	-
Chloride	mg/L	-	-	4	-
TDS	mg/L	-	-	600	-
Phenols	ug/L	1000	110	260	-
pH	-	7.17	7.48	7.00	-
Conductivity	u mhos/cm	780	765	900	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point Sample Date Data Source		P-25 04/04/80 Hooker (1980)	P-25 06/17/80 Hooker (1980)	P-25 06/28/82 Occidental (1982)	P-25 06/28/82 NYSDEC (1982a)
	Units				
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	ND(1)	ND(1)
Toluene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(20)	ND(10)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	-
TOC	ug/mL	-	-	90	-
Chloride	mg/L	-	-	17	-
TDS	mg/L	-	-	700	-
Phenols	ug/L	ND(10)	20	ND(100)	-
pH	-	7.42	7.39	7.20	-
Conductivity	u mhos/cm	1270	890	1050	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

GTC

Sample Point Sample Date Data Source		P-26 04/04/80 Hooker (1980)	P-26 06/17/80 Hooker (1980)	P-26 06/30/82 Occidental (1982)	P-26 06/30/82 NYSDEC (1982a)
	Units				
o-Chlorophenol	ug/L	-	-	17	ND(10)
p-Chlorophenol	ug/L	-	-	8800	1520
2,4,5-Trichlorophenol	ug/L	-	-	130	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	330	200
Benzene	ug/L	-	-	100	82
Toluene	ug/L	2400	3300	4200	630
Monochlorobenzene	ug/L	-	1200	1200	750
o-Chlorotoluene	ug/L	-	-	27	38
o-Dichlorobenzene	ug/L	13	15	ND(1)	72
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	12	15	150	94
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	410	-
TOC	ug/mL	-	-	162	-
Chloride	mg/L	-	-	57	-
TDS	mg/L	-	-	650	-
Phenols	ug/L	23000	5100	15600	-
pH	-	6.46	7.75	6.70	-
Conductivity	u mhos/cm	1640	1070	900	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source	Units	P-27 04/02/80 Hooker (1980)	P-28 04/02/80 Hooker (1980)	P-28 06/18/80 Hooker (1980)	P-29 04/02/80 Hooker (1980)
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	-	-	-	-
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	ND(20)	ND(20)	ND(10)	ND(20)
o-Chlorotoluene	ug/L	-	-	-	-
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	-	-
TOC	ug/mL	-	-	-	-
Chloride	mg/L	-	-	-	-
TDS	mg/L	-	-	-	-
Phenols	ug/L	14	14	2	42
pH	-	6.96	7.73	7.49	7.37
Conductivity	u mhos/cm	1600	1470	1210	965

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source		P-29 Summer 82 Occidental (1982)	P-30 04/02/80 Hooker (1980)	P-31 Summer 82 Occidental (1982)	P-33 07/01/82 Occidental (1982)
	Units				
o-Chlorophenol	ug/L	-	-	-	-
p-Chlorophenol	ug/L	-	-	-	-
2,4,5-Trichlorophenol	ug/L	-	-	-	-
2,4,6-Trichlorophenol	ug/L	-	-	-	-
Benzene	ug/L	ND(1)	-	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(10)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(20)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	-	ND(10)	-	-
1,2,4-Trichlorobenzene	ug/L	-	ND(10)	-	-
1,3,5-Trichlorobenzene	ug/L	-	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	ND(1)
TOC	ug/mL	-	-	-	79
Chloride	mg/L	12	-	140	62
TDS	mg/L	450	-	1200	750
Phenols	ug/L	-	23	-	ND(100)
pH	-	7.05	7.55	6.85	6.80
Conductivity	u mhos/cm	650	1870	1850	1280

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

GTC

Sample Point / Sample Date / Data Source		P-33 07/01/82 NYSDEC (1982a)	P-34 07/19/82 Occidental (1982)	P-34 07/19/82 NYSDEC (1982a)	NP-2 07/14/82 Occidental (1982)
	Units				
o-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Benzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,2,4-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,3,5-Trichlorobenzene	ug/L	-	-	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	ND(1)	-	ND(1)
TOC	ug/mL	-	67	-	60
Chloride	mg/L	-	6	-	510
TDS	mg/L	-	500	-	1700
Phenols	ug/L	-	ND(100)	-	ND(100)
pH	-	-	6.80	-	6.40
Conductivity	u mhos/cm	-	900	-	2500

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

GTC

Sample Point Sample Date Data Source		NP-2 07/14/82 NYSDEC (1982a)	NP-4 07/19/82 Occidental (1982)	NP-4 07/19/82 NYSDEC (1982a)	NP-6 07/19/82 Occidental (1982)
	Units				
o-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Benzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,2,4-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,3,5-Trichlorobenzene	ug/L	-	-	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	ND(1)	-	ND(1)
TOC	ug/mL	-	51	-	55
Chloride	mg/L	-	270	-	42
TDS	mg/L	-	850	-	500
Phenols	ug/L	-	ND(100)	-	ND(100)
pH	-	-	7.00	-	7.05
Conductivity	u mhos/cm	-	1525	-	880

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source		NP-6 07/19/82 NYSDEC (1982a)	NP-7 07/01/82 Occidental (1982)	NP-7 07/01/82 NYSDEC (1982a)	NP-8 07/01/82 Occidental (1982)
	Units				
o-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	ND(10)	19	ND(10)	ND(10)
Benzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,2,4-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
1,3,5-Trichlorobenzene	ug/L	-	-	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	ND(1)	-	ND(1)
TOC	ug/mL	-	85	-	60
Chloride	mg/L	-	500	-	110
TDS	mg/L	-	1400	-	1000
Phenols	ug/L	-	ND(100)	-	ND(100)
pH	-	-	6.80	-	7.00
Conductivity	u mhos/cm	-	3000	-	1310

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units.

" - " - not analyzed for

" * " - field data

GTC

Sample Point / Sample Date / Data Source		NP-8 07/01/82 NYSDEC (1982a)	NP-9 07/01/82 NYSDEC (1982a)	NP-9 07/01/82 Occidental (1982)	NP-10 06/28/82 Occidental (1982)
	Units				
o-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Benzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(1)	ND(1)	-	-
1,2,4-Trichlorobenzene	ug/L	ND(1)	ND(1)	-	-
1,3,5-Trichlorobenzene	ug/L	-	-	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	ND(1)
TOC	ug/mL	-	-	106	44
Chloride	mg/L	-	-	340	2000
TDS	mg/L	-	-	2400	3900
Phenols	ug/L	-	-	ND(100)	ND(100)
pH	-	-	-	6.70	7.30
Conductivity	u mhos/cm	-	-	2700	6500

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

Sample Point / Sample Date / Data Source	Units	NP-10 06/28/82 NYSDEC (1982a)	NP-11 07/14/82 NYSDEC (1982a)	NP-11 07/14/82 Occidental (1982)
o-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)
p-Chlorophenol	ug/L	ND(10)	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(10)	ND(10)
Benzene	ug/L	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	ND(1)	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	-	-	-
p-Dichlorobenzene	ug/L	ND(1)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(1)	ND(1)	-
1,2,4-Trichlorobenzene	ug/L	ND(1)	ND(1)	-
1,3,5-Trichlorobenzene	ug/L	-	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)
TOC	ug/mL	-	-	110
Chloride	mg/L	-	-	17
TDS	mg/L	-	-	800
Phenols	ug/L	-	-	ND(100)
pH	-	-	-	6.65
Conductivity	u mhos/cm	-	-	1075

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

" * " - field data

APPENDIX IIb

Analysis Results for Storm Sewer Samples

	Sample Point Sample Date Data Source	SS-1 04/07/80 Hooker (1980)	SS-1 06/11/80 Hooker (1980)	SS-2 04/07/80 Hooker (1980)	SS-2 06/11/80 Hooker (1980)
	Units				
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(10)	-	ND(10)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	10	ND(10)	ND(10)	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Phenols	ug/L	41	30	35	30
pH	-	7.53	7.31	7.61	7.65
Conductivity	u mhos/cm	559	465	1100	1180

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point Sample Date Data Source		SS-3 04/07/80 Hooker (1980)	SS-3 06/11/80 Hooker (1980)	SS-4 04/07/80 Hooker (1980)	SS-4 06/11/80 Hooker (1980)
	Units				
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(10)	-	ND(10)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	38	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	16	14	35	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Phenols	ug/L	1800	97	1600	310
pH	-	7.68	7.73	7.65	7.57
Conductivity	u mhos/cm	660	350	700	390

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point / Sample Date / Data Source	Units	SS-5 04/07/80 Hooker (1980)	SS-5 06/11/80 Hooker (1980)	SS-6 04/07/80 Hooker (1980)	SS-6 06/11/80 Hooker (1980)
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(10)	-	ND(10)
o-Dichlorobenzene	ug/L	94	ND(10)	57	62
m-Dichlorobenzene	ug/L	16	ND(10)	ND(10)	58
p-Dichlorobenzene	ug/L	59	10	44	53
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Phenols	ug/L	1600	440	1800	1100
pH	-	7.65	7.72	7.65	7.78
Conductivity	u mhos/cm	758	382	682	425

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point Sample Date Data Source		SS-7 04/07/80 Hooker (1980)	SS-7 06/11/80 Hooker (1980)	SS-8 04/07/80 Hooker (1980)	SS-8 06/11/80 Hooker (1980)
	Units				
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(10)	-	ND(10)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Phenols	ug/L	17000	4900	9200	600
pH	-	6.94	7.75	7.02	7.47
Conductivity	u mhos/cm	598	435	560	475

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point Sample Date Data Source		SS-9 04/07/80 Hooker (1980)	SS-9 06/11/80 Hooker (1980)	SS-10 04/07/80 Hooker (1980)	SS-10 06/11/80 Hooker (1980)
	Units				
Toluene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Monochlorobenzene	ug/L	-	ND(10)	-	ND(10)
o-Dichlorobenzene	ug/L	18	ND(10)	23	ND(10)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	12	ND(10)
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	10	ND(10)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	ND(10)	ND(10)
Phenols	ug/L	3100	269	3700	234
pH	-	7.30	7.53	7.27	7.64
Conductivity	u mhos/cm	493	470	571	451

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point / Sample Date / Data Source	Units	4R Summer 82 Occidental (1982)	4R+ 04/27/82 NYSDEC (1982b)	6A Summer 82 Occidental (1982)	6A 04/27/82 NYSDEC (1982b)
o-Chlorophenol	ug/L	ND(10)	ND(2)	ND(10)	ND(2)
p-Chlorophenol	ug/L	ND(10)	ND(2)	ND(10)	ND(2)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(0.5)	ND(10)	ND(0.5)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(0.5)	ND(10)	ND(0.5)
Benzene	ug/L	2	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(1)	ND(2)	ND(1)	ND(2)
o-Chlorotoluene	ug/L	ND(1)	6.2*	ND(1)	4.9*
o-Dichlorobenzene	ug/L	2	6.2*	ND(1)	4.9*
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	3	10	ND(1)	7.8
1,2,3-Trichlorobenzene	ug/L	-	4.4	-	2.9
1,2,4-Trichlorobenzene	ug/L	-	1.1	-	2.9
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	ND(1)	-	ND(1)	-
TOC	ug/mL	22	400	26	8.5
Chloride	mg/L	24	-	100	-
TDS	mg/L	200	-	300	-
Phenols	ug/L	650	7500	ND(100)	ND(10)
pH	-	7.00	7.43	7.7	7.58
Conductivity	u mhos/cm	360	501	480	2500

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Notes: " + " - results from filtered samples

" * " - analysis method did not allow for separate determination of o-Chlorotoluene and 1,2-Dichlorobenzene. Values for these compounds should be interpreted as concentration present for o-Chlorotoluene and/or 1,2-Dichlorobenzene

- NYSDEC (1982b) does not differentiate for filtered and unfiltered benzene and toluene analyses

GTC

Sample Point / Sample Date / Data Source	Units	6A+ 04/27/82 NYSDEC (1982b)	6B Summer 82 Occidental (1982)	6B 04/27/82 NYSDEC (1982b)	6B+ 04/27/82 NYSDEC (1982b)
o-Chlorophenol	ug/L	ND(2)	ND(10)	ND(2)	ND(2)
p-Chlorophenol	ug/L	ND(2)	ND(10)	ND(2)	ND(2)
2,4,5-Trichlorophenol	ug/L	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)
2,4,6-Trichlorophenol	ug/L	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)
Benzene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Toluene	ug/L	ND(1)	ND(1)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(2)	ND(1)	ND(2)	ND(2)
o-Chlorotoluene	ug/L	1.1*	ND(1)	ND(0.5)*	ND(0.5)*
o-Dichlorobenzene	ug/L	1.1*	ND(1)	ND(0.5)*	ND(0.5)*
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	2.5	ND(1)	1.9	3.2
1,2,3-Trichlorobenzene	ug/L	ND(0.5)	-	ND(0.5)	ND(0.5)
1,2,4-Trichlorobenzene	ug/L	ND(0.5)	-	ND(0.5)	ND(0.5)
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	ND(1)	-	-
TOC	ug/mL	85	24	16	14
Chloride	mg/L	-	190	-	-
TDS	mg/L	-	450	-	-
Phenols	ug/L	ND(10)	ND(100)	32	23
pH	-	7.64	7.5	7.67	7.83
Conductivity	u mhos/cm	2240	715	1340	1340

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Notes: " + " - results from filtered samples

" * " - analysis method did not allow for separate determination of o-Chlorotoluene and 1,2-Dichlorobenzene. Values for these compounds should be interpreted as concentration present for o-Chlorotoluene and/or 1,2-Dichlorobenzene

- NYSDEC (1982b) does not differentiate for filtered and unfiltered benzene and toluene analyses

GTC

Sample Point / Sample Date / Data Source	Units	6K Summer 82 Occidental (1982)	6K+ 04/27/82 NYSDEC (1982b)	Nash/Walck 04/08/82 Occidental (1982)	Nash/Walck 04/08/82 NYSDEC (1982b)
o-Chlorophenol	ug/L	ND(10)	ND(2)	16	ND(2)
p-Chlorophenol	ug/L	11	ND(2)	ND(10)	ND(2)
2,4,5-Trichlorophenol	ug/L	ND(10)	ND(0.5)	ND(10)	ND(0.5)
2,4,6-Trichlorophenol	ug/L	ND(10)	ND(0.5)	ND(10)	ND(0.5)
Benzene	ug/L	27	96	19	250
Toluene	ug/L	4	21	1	15
Monochlorobenzene	ug/L	180	ND(2)	120	ND(2)
o-Chlorotoluene	ug/L	70	25*	68	49*
o-Dichlorobenzene	ug/L	62	25*	52	49*
m-Dichlorobenzene	ug/L	-	-	-	-
p-Dichlorobenzene	ug/L	258	65	240	130
1,2,3-Trichlorobenzene	ug/L	-	2.5	-	2.9
1,2,4-Trichlorobenzene	ug/L	-	0.54	-	1.2
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	11	-	10	-
TOC	ug/mL	21	3.5	31	60
Chloride	mg/L	53	-	53	-
TDS	mg/L	250	-	250	-
Phenols	ug/L	400	1100	200	2700
pH	-	7.7	7.61	7.5	5.81
Conductivity	u mhos/cm	425	468	350	521

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Notes: " + " - results from filtered samples

" * " - analysis method did not allow for separate determination of o-Chlorotoluene and 1,2-Dichlorobenzene. Values for these compounds should be interpreted as concentration present for o-Chlorotoluene and/or 1,2-Dichlorobenzene

- NYSDEC (1982b) does not differentiate for filtered and unfiltered benzene and toluene analyses

Sample Point Sample Date Data Source		Nash/Walck+ 04/08/82 NYSDEC (1982b)
	Units	
o-Chlorophenol	ug/L	ND(2)
p-Chlorophenol	ug/L	ND(2)
2,4,5-Trichlorophenol	ug/L	ND(0.5)
2,4,6-Trichlorophenol	ug/L	ND(0.5)
Benzene	ug/L	250
Toluene	ug/L	15
Monochlorobenzene	ug/L	ND(2)
o-Chlorotoluene	ug/L	31*
o-Dichlorobenzene	ug/L	31*
m-Dichlorobenzene	ug/L	-
p-Dichlorobenzene	ug/L	75
1,2,3-Trichlorobenzene	ug/L	2.0
1,2,4-Trichlorobenzene	ug/L	0.72
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-
TOC	ug/mL	16
Chloride	mg/L	-
TDS	mg/L	-
Phenols	ug/L	1400
pH	-	7.14
Conductivity	u mhos/cm	545

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Notes: " + " - results from filtered samples

" * " - analysis method did not allow for separate determination of o-Chlorotoluene and 1,2-Dichlorobenzene. Values for these compounds should be interpreted as concentration present for o-Chlorotoluene and/or 1,2-Dichlorobenzene

- NYSDEC (1982b) does not differentiate for filtered and unfiltered benzene and toluene analyses

APPENDIX IIc

Analysis Results for Water Samples From Deep Wells W-7, W-12, W-16 and W-17

NOTE: The only date available from Occidental (1982) was "Summer 1982". Dates for Occidental (1982) data were assigned on the basis that the samples analyzed were split samples also analyzed by NYSDEC (1982a) for which sampling dates are available. If no NYSDEC (1982a) analysis was available for a specific piezometer the date "Summer 1982" is used for Occidental (1982) data.

Sample Point Sample Date Data Source	Units	W-7 04/03/80 Hooker (1980)	W-7 06/12/80 Hooker (1980)	W-7 07/21/82 Occidental (1982)	W-7 07/21/82 NYSDEC (1982a)
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	2	ND(1)
Toluene	ug/L	ND(10)	240	19	10
Monochlorobenzene	ug/L	ND(20)	ND(10)	ND(1)	1
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	1
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	-
TOC	ug/mL	-	-	34	-
Chloride	mg/L	-	-	440	-
TDS	mg/L	-	-	3700	-
Phenols	ug/L	18	75	ND(100)	-
pH	-	7.28	7.71	7.20	-
Conductivity	u mhos/cm	4120	3970	3900	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point / Sample Date / Data Source	Units	W-12 04/03/80 Hooker (1980)	W-12 06/12/80 Hooker (1980)	W-12 07/21/82 Occidental (1982)	W-12 07/21/82 NYSDEC (1982a)
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	ND(1)	ND(1)
Toluene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(20)	ND(10)	3	1
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	-
TOC	ug/mL	-	-	43	-
Chloride	mg/L	-	-	450	-
TDS	mg/L	-	-	3200	-
Phenols	ug/L	60	11	ND(100)	-
pH	-	-	7.63	7.10	-
Conductivity	u mhos/cm	-	3720	3000	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

Sample Point / Sample Date / Data Source	Units	W-16 04/03/80 Hooker (1980)	W-16 06/12/80 Hooker (1980)	W-16 07/21/82 Occidental (1982)	W-16 07/21/82 NYSDEC (1982a)
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	ND(1)	ND(1)
Toluene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
Monochlorobenzene	ug/L	ND(20)	ND(10)	ND(1)	ND(1)
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	-
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	ND(1)	-
TOC	ug/mL	-	-	32	-
Chloride	mg/L	-	-	480	-
TDS	mg/L	-	-	3700	-
Phenols	ug/L	19	ND(10)	ND(100)	-
pH	-	7.14	7.56	6.95	-
Conductivity	u mhos/cm	4300	4110	4000	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

GTC

Sample Point / Sample Date / Data Source	Units	W-17 04/03/80 Hooker (1980)	W-17 06/12/80 Hooker (1980)	W-17 07/21/82 Occidental (1982)	W-17 07/21/82 NYSDEC (1982a)
o-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
p-Chlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,5-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
2,4,6-Trichlorophenol	ug/L	-	-	ND(10)	ND(10)
Benzene	ug/L	-	-	2	ND(1)
Toluene	ug/L	ND(10)	ND(10)	2	ND(1)
Monochlorobenzene	ug/L	ND(20)	ND(10)	21	11
o-Chlorotoluene	ug/L	-	-	ND(1)	ND(1)
o-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
m-Dichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
p-Dichlorobenzene	ug/L	ND(10)	ND(10)	ND(1)	ND(1)
1,2,3-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,2,4-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	ND(1)
1,3,5-Trichlorobenzene	ug/L	ND(10)	ND(10)	-	-
1,2,3 & 1,2,4-Trichlorobenzene	ug/L	-	-	1	-
TOC	ug/mL	-	-	29	-
Chloride	mg/L	-	-	3000	-
TDS	mg/L	-	-	8200	-
Phenols	ug/L	ND(10)	ND(10)	ND(100)	-
pH	-	6.98	7.34	7.05	-
Conductivity	u mhos/cm	13400	10900	10000	-

Notation: ND(x) - not detected at or above the value of x in the specified units

LT(x) - detected, but at a value less than x in the specified units

" - " - not analyzed for

APPENDIX IId

TCDD Analysis Results for Soil Borings
and Sewer Samples

GTC

Sample Point Sample Date	Units	P-21 05/28/82	P-26 05/28/82	P-29 06/04/82	P-33 06/04/82
Analysis Number	-	SS-2	SS-1	SS-4	SS-3
Moisture Content	%	18.2	14.2	18.0	15.8
Total TCDD	ng/kg	ND(90)	ND(48)	ND(78)	ND(90)
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(90)	ND(48)	ND(78)	ND(90)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

Sample Point / Sample Date	Units	P-34 06/04/82	P-34 06/04/82	P-34 06/04/82	P-36 06/02/82
Analysis Number	-	SS-2	SS-2	SS-2	SS-2
Moisture Content	%	16.4	16.4	16.4	15.6
Total TCDD	ng/kg	ND(90)	ND(60)	ND(93)	ND(99)
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(90)	ND(60)	ND(93)	ND(99)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Soúrce: Occidental (1982)

Sample Point Sample Date	Units	NP-1 05/26/82	NP-2 06/03/82	NP-3 05/27/82	NP-3 05/27/82
Analysis Number	-	SS-3	SS-1	SS-2	SS-2D
Moisture Content	%	13.8	16.0	15.6	15.6
Total TCDD	ng/kg	ND(260)	ND(78)	6500	4500
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(260)	ND(78)	690	390

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

Sample Point / Sample Date	Units	NP-3 05/27/82	NP-3 05/27/82	NP-3 05/27/82	NP-3 05/27/82
Analysis Number	-	SS-4	SS-4	SS-3	SS-3
Moisture Content	%	15.6	15.6	15.6	15.6
Total TCDD	ng/kg	290	310	ND(93)	ND(230)
2,3,7,8-TCDD & co-eluting isomers	ng/kg	*	ND(60)	ND(93)	ND(230)

*data was lost in laboratory

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

Sample Point / Sample Date	Units	NP-4 06/02/82	NP-4 06/02/82	NP-5 06/04/82	NP-6 06/02/82
Analysis Number	-	SS-1	SS-2	SS-2	SS-3
Moisture Content	%	17.0	17.0	16.8	16.0
Total TCDD	ng/kg	160	470	ND(57)	ND(90)
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(96)	ND(51)	ND(57)	ND(90)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

GTC

Sample Point Sample Date	Units	NP-6 06/02/82	NP-7 06/01/82	NP-8 06/01/82	NP-8 06/01/82
Analysis Number	-	SS-3	SS-1	SS-2	SS-1
Moisture Content	%	16.0	17.0	16.0	16.0
Total TCDD	ng/kg	ND(93)	190	1300	1100
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(93)	ND(110)	ND(96)	ND(60)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Data Source: Occidental (1982)

Sample Point / Sample Date	Units	NP-9 06/01/82	NP-11 06/03/82	NP-11 06/03/82
Analysis Number	-	SS-3	SS-1	SS-3
Moisture Content	%	15.0	14.8	14.8
Total TCDD	ng/kg	ND(60)	910	110
2,3,7,8-TCDD & co-eluting isomers	ng/kg	ND(60)	670	72

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.1, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

Sample Point	Units	6A	6B	6K	Walck/Nash
Analysis Number	-	SW-2	SW-3	SW-3	SW-1
Total TCDD	ng/L	ND(2)	ND(2)	ND(2)	ND(2)
2,3,7,8-TCDD & co-eluting isomers	ng/L	ND(2)	ND(2)	ND(2)	ND(2)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.2, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)

Sample Point	Units	4R	4R
Analysis Number	-	SW-1	SW-2
Total TCDD	ng/L	4	ND(2)
2,3,7,8-TCDD & co-eluting isomers	ng/L	ND(2)	ND(2)

Notation: ND(x) - not detected at or above the value of x in the specified units

Note: Analysis Number is suffix from C.S. Workup in Table 3.2, Section III of Occidental (1982)

Sample date is date of drilling from well logs (Occidental, 1982)

Data Source: Occidental (1982)